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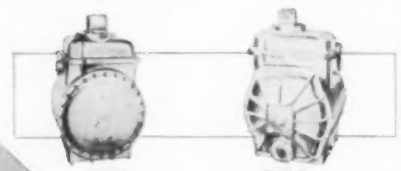

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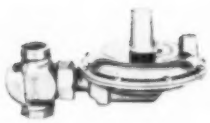

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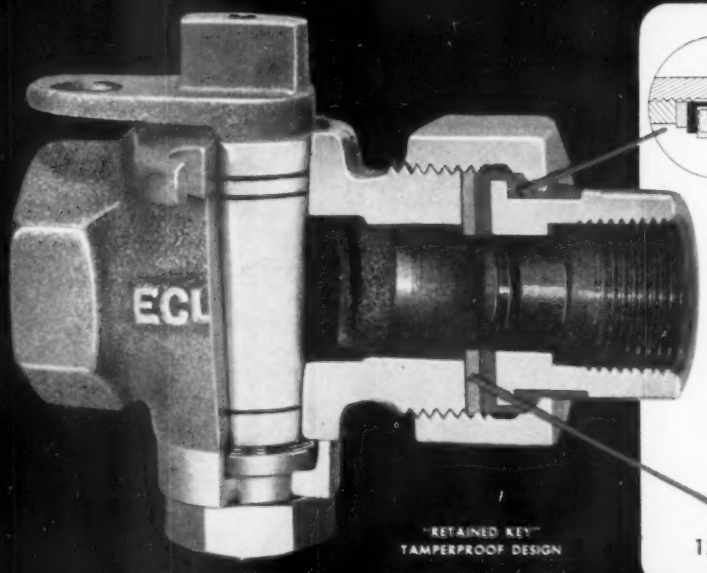

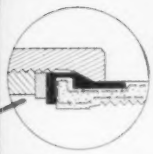

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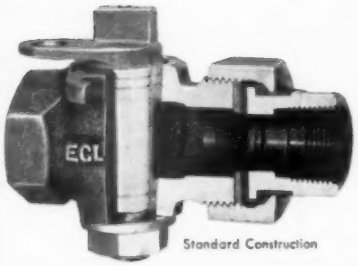

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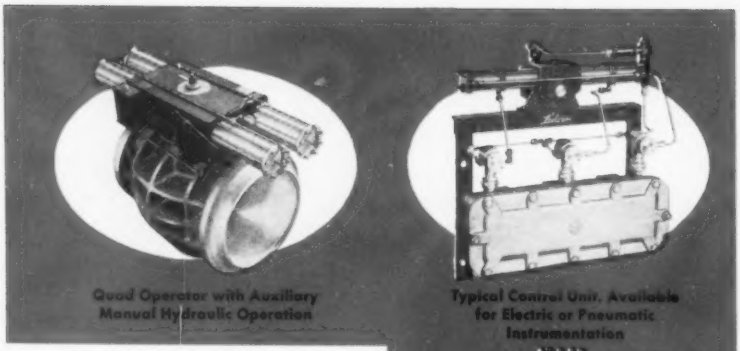
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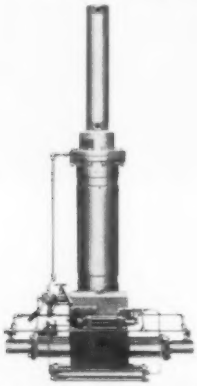

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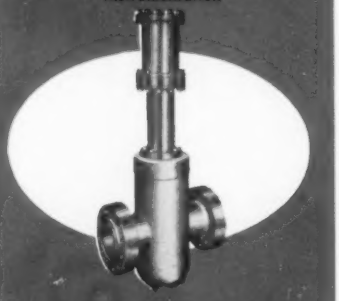

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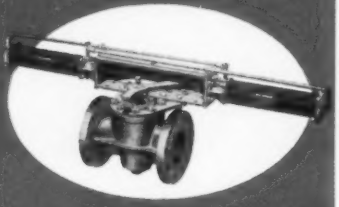

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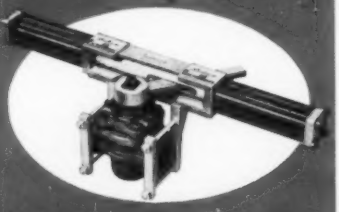

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SEPTEMBER 1958

Thermally Thinking

IN early August, Natural Gas Pipeline Co. of America and Colorado Interstate Gas Co. agreed to shut-down the Beatrice project. Thus ends plans for a new Colorado Interstate pipeline betwen Kit Carson, Wyo., and Beatrice, Neb., and a new Natural Gas Pipe pipeline looping its existing system from Beatrice on into Joliet, Ill. These plans would have brought an additional 485 MMcf per day to Chicago and other cities of the Midwest.

Colorado Interstate will take some of the gas it had ticketed for the Midwest to the West Coast (see page 112). Producers become very bored when withholding large volumes of gas from market for any length of time. This is at least true for U. S. gas suppliers. Canadian producers must have inexorable patience.

Reasons given for cancellation of the Beatrice projects agreements by mutual consent are: (1) time delay in schedule beyond the control of both companies, and (2) the Memphis decision, which, among a few other things, contributed to more than a smattering of the delay, and presented other obstacles.

So, one of the two most important projects for bringing comfortable volumes of natural gas to the Midwest has folded. The other is the Midwestern Gas Transmission proposal which has been entangled with FPC for a good long time.

We are not prepared to judge the relative merits of the several plans to bring badly needed additional gas supply into the Midwest. However, I have an opinion and have had one for some time—which is, apparently, much better than FPC has been able to do since they have been mulling the situation over interminably.

The shocking thing about the whole matter is that there are roughly 150,000 homes waiting for gas space heating in metropolitan Chicago. At the peak of gas supply shortage or customer application influx, some 250,000 customers were on the "books" as wanting gas space heating service, but denied it by restrictions—which is just another way of saying a gas shortage.

Who or what is to blame for this sorry situation? The gas industry? No, I don't think so because Midwestern Gas Transmission stood ready to serve the Chicago area and other customers in cities of the Midwest. Also, The Peoples Gas Light & Coke Co. group was cutting away at the space heating customer backlog. And their Beatrice application of February 1956 showed intent to slice it severely, albeit the filing wasn't made until the same day the Midwestern Gas Transmission hearings broke loose. Other plans were also around or allegedly in the mill.

Federal Power Commission is not to blame because its responsibility and authority pertaining to natural gas originate from the Natural Gas Act, June 21, 1938, as amended (15.U.S.C. 717-717w), and Executive Order 10485, Sept. 3, 1953. In other words, it is a quasi-legislative, quasi-judicial, executive, and administrative agency of the public mind, designed to look after this country's natural gas and electric power.

The fault lies with the people of the Midwest area. Obviously they need natural gas for space heating and the way to get it is to stand on their hind legs and yell their heads off. Had they dropped their cloak of apathy four years ago, they would have more gas supply than they would know what to do with. It happens that political and governmental ears are very finely tuned to even the first whisper of a mass clamor from a healthy number of voting Americans. Both the Beatrice and part of the Midwestern Gas projects could be in operation right now.

Gas company and industry public relations people can shoulder some of the blame. Democracy works only when the public is informed. Two or three hundred-thousand voters who know what they want and how to really holler for it can get darn near anything out of government as we know it in the United States today. From the gas companies' view points, this was a public relations job. Not, I will be careful to point out, to tell these people what they want, but to keep them informed on this gas supply matter. Had the people of the Midwest been informed, I think there would not be waiting lists for space heating service in their area today.

J. Fred Ebsen
EDITOR

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GAS HIGHLIGHTS

Garbage dump in Chicago hotel lobby

Lounge-lizards and civic leaders alike will look and sniff as garbage is consumed in a smokeless-odorless gas-fired incinerator in the lobby of Chicago's Blackstone on Sept. 11. Event paces first all-out major market push to sell this new gas appliance. The Peoples Gas Light & Coke Co., Northern Illinois Gas Co., North Shore Gas Co., Northern Indiana Public Service Co., and other utilities join with GAMA-member manufacturers in spending more than $110,000 on this campaign. Watch it roll.

No additional gas for Transco's customers this year

The company feels it has done all it can do to speed the case for its expansion program (FPC Docket G-13143 et al). Major part of these plans were filed Oct. 28, 1957 (Docket G-13590). Figure there's not enough time left in this construction season.

Keeping cool these days?

Lots of people are—more than ever are doing it with gas. AGA reports gas air conditioning sales are up over 1957, which wasn't a real great year. The figures: 1305 units in first six months of '57, compared with 3436 in same period this year. The forecast: 7000 domestic A/C units for '58; only 2467 shipped last year.

Transwestern backs off; takes another start

Initial deliveries were cut 50 MMcf per day to 300 as Transwestern Pipeline Co. overhauled the boiler-works of its FPC application with a late July amendment. Also, gas supply was firmed up; field prices remained unchanged (said to be pretty high, by some reports); upped the price to Pacific Lighting Gas Supply; and juggled their financing slightly.

And baby makes three

From Regeimbal in the nation's capitol comes word that the pundits there look for a fresh boom in home building. Peak near 1.3 million (the standing record) is expected. New home starts in June hit 115,000 —15 per cent above the same month of 1957. Easier FHA climates aren't hurting anything in the home-building trade.

Municipals reach for red ink bottle again

Municipally owned gas distribution systems again operated in the red during 1957. Total municipal gas system expenditures—$104.7 million; total revenues, $99.4 million. The total expenditure by municipals increased from $90 million in '56, $88 million in '55, $61 million in '54, and $48 million in '53—good indication that the number of municipal gas systems is increasing, if any indication is needed.

Some real gassers

Recent reports show exploration and wildcat drilling for new gas reserves is now equally successful as the search for crude oil. Hasn't been so in the past. Estimates of 1 gas-productive wildcat strike out of nearly 11 wells drilled in search of new-field gas reserves seems valid. Ratio of gas discoveries to oil discoveries is improving all the time.

Americans on the go

The Department of Commerce says one in every five persons in the U. S. moved from one residence to another during year ending in April 1957. Points up the problems of gas appliance removal and reinstallation and shows a market for new gas appliances—nearly everybody likes new appliances for a new or different residence.

No joy in Edisonville, man

The gas light phenomena is making the electric industry sit up and think. Civic squares, airports, parking lots, etc., are starting to show exciting commercial and industrial application for this "new" gas appliance. Arkla Air Conditioning is turning them out at 1200 per day. 'Nuff said.

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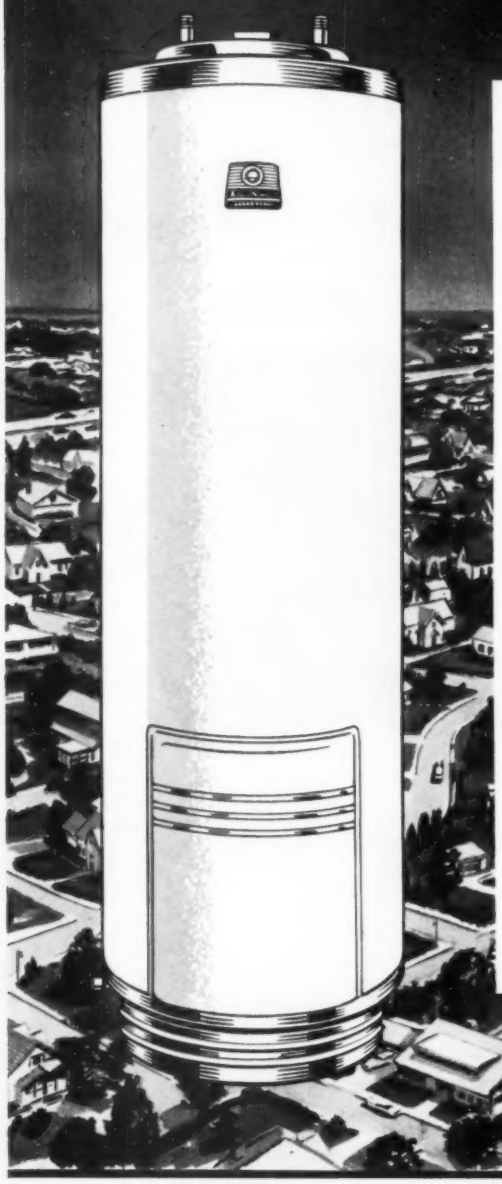

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Regulatory and Legislative Trends

A COMMENTARY ON NATIONAL AND STATE DEVELOPMENTS BY AN EXPERT IN UTILITY LAW

Private mobile radio rings the bell

THE Bell Telephone system is ringing over its recent victory in the California Supreme Court. The majority of justices in that high court ruled that the Pacific Telephone Co., a member of the Bell System, is rendering a public utility service by leasing and maintaining mobile radio equipment for owners of private radio licenses.

The court affirmed the Public Utilities Commission's decision that such communications service, offered to all eligible persons, was subject to price regulation. Gas, electric and other companies which possess radio licenses from the Federal Communications Commission can choose between owning radio equipment and leasing it from Bell or a competitor. To qualify under Pacific's tariff schedule for communications equipment, one must have an FCC radio station license, authorized operators, exclusive control of the facilities, responsibility for operation in compliance with FCC rules, and unrestricted access to land radio station equipment located on Pacific's property. Pacific undertakes only to furnish, install and maintain the radio equipment. Radio communication takes place between land and mobile stations, or between two mobile stations. A land station is a fixed radio telephone station used with a private mobile communication system as a base station. A mobile station in a moving vehicle is comprised of a radio transmitter, a receiver, microphone and an antenna. Given an allocated radio wave length, the licensee has privacy of communication.

• Private mobile communications

Private mobile communication systems differ from public mobile communication systems. Pacific, as a common carrier telephone company, is licensed by FCC to operate public systems over the radio frequencies allocated for this public use. It may install radiotelephone equipment in the vehicle of a subscriber for this use, but all calls must be completed through the company's central office, with the intervention of a company operator to ask for a number and to make the connection. Calls in any number may be made on the company's exchange system throughout the world. This service can be furnished only by a public utility telephone company. It is appropriate and effective for persons needing occasional communication with their vehicles or with their offices.

Private mobile communication service fulfills a more specialized need. Where a continuously free channel is required, it is more efficacious. After the close of World War II and the Korean conflict, government, industry and many organizations began to make extensive use of this type of service for quick, private communication with employees in trucks and automobiles, and there is an increasing demand for the service. It is widely known in connection with its use by gas companies, law enforcement officers and taxicab companies.

• Utility nature of service

The opponents urged that in furnishing these radio systems on a lease-maintenance basis Pacific is merely engaging in an equipment service, not a "telephone service."

The court reasoned that the California law intended that ownership of any plant or equipment would be sufficient and that operation and control were not made prerequisites to PUC jurisdiction. It is therefore immaterial that Pacific does not remain in control of the equipment or that it does not furnish the radio channel over which the equipment is operated. These are matters of limitation imposed by the federal commission. The requirement that there be no interconnection with the general toll and switching facilities of Pacific is also imposed by the federal commission and acquiesced in by Pacific.

The fact, asserted the court, that private mobile communication systems may be obtained from sources other than a public utility, does not detract from the utility nature of this service which is offered to the public under a voluntarily filed tariff. Regulated and nonregulated services compete in many fields and there is no requirement that telephone service may be offered only by a monopoly.

The real issue presented, said the court, is whether the service offered by the proposed tariff is "for the transmission of telephone messages" or "in connection with and to facilitate communication by telephone."

The word "telephone" is not defined in the code. In its narrow sense "telephone" refers to the instrument by which telephony is achieved. It is defined in Webster's New International Dictionary, 2d edition as "An instrument for reproducing sounds, especially articulate speech, at a distance." In defining "telephony" the Encyclopaedia Britannica states "In a broad sense the term telephone or telephony includes the entire art of speech transmission with the many accessories and operating methods which research, development and invention have supplied to facilitate and extend conversation at a distance by electrical means." While mobile communication involves an application of the art of radio to

telephone communication, it is more akin to telephony than to radio broadcasting.

In determining whether Pacific is offering a telephone service, the court considered it to be basic that what a telephone company actually provides and maintains is the facilities for the transmission of telephone messages. In its earliest beginnings this transmission was over a single iron wire connecting two telephone instruments with ground return circuits. It was over such a wire that Alexander Graham Bell called to his startled assistant, "Mr. Watson, come here, I want you." That was in March 1876. Many technological improvements in the art of telephony have been made, including radiotelephony and the instruments used for carrying on conversations at great distances. The exact form of the transmitter and the receiver or the medium over which the communication can be effected is not prescribed by law. In common understanding the communication effected by private mobile systems would appear to be a telephone communication. Among the other uses of radio is the transmission of telephone messages without the use of wires. Today ordinary toll telephone service is furnished as much by radio as by land lines and Pacific operates about 350,000 toll circuit miles of microwave radio relay in California. It also uses radio for such diverse services as rural subscriber lines, coastal harbor service and highway service. All of these are treated as public telephone service under filed tariffs. Because of the physical nature of the medium here used (radio), the private nature of the communication contemplated and the restrictions established by the federal commission, private radiotelephone differs in some respects from public radiotelephone service and also from land line telephone service. Nevertheless the court declared that it is a telephone service and when Pacific dedicated that service to public use it became subject to the jurisdiction of the California Public Utilities Commission.

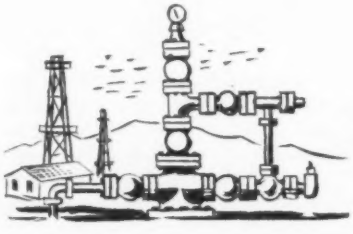
• Equal protection of the law and public interest

The court concluded that the opponents are not denied equal protection of the law by the fact that a regulated utility company competes with them in this radio lease-maintenance service. The commission found that there was no unfair competition by Pacific in this field, and ruled that it would not allow Pacific to give its private mobile customers services which it would not make available to the customers of its competitors and that it would require Pacific to maintain charges which would be fully compensatory.

There is no sound basis for the contention, ruled the court, that the regulation of this service is outside the permissible sphere of government regulation and that it contravenes the 14th Amendment. There are several respects in which the private mobile communication systems are of public concern. The evidence shows that these systems are for a considerable part used by public transportation companies, trucking companies, law enforcement agencies, fire departments, and utility companies. Their purpose is the maintaining of communication with vehicles moving on the public streets and highways. The medium used is radio and is generally of public concern.

• Consent decree

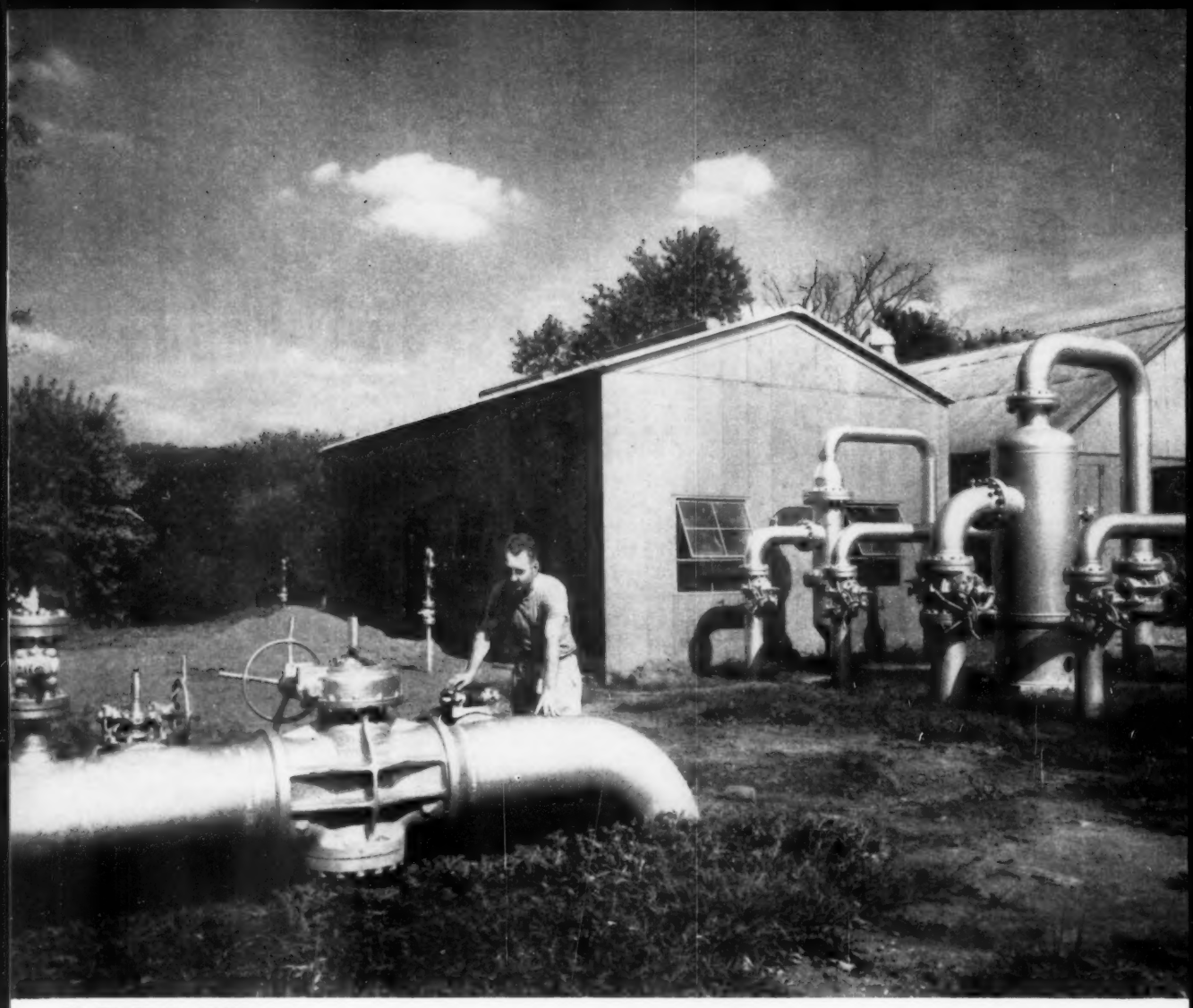
In January 1956 the Department of Justice brought a proceeding under the Sherman Act in the United States District Court in New Jersey against the Bell Telephone System, including Western Electric Co. By consent of the parties and without trial of the issues a consent decree was entered. Under the federal antitrust laws where no trial is had a consent decree is not an admission of any of the charges contained in the complaint. The New Jersey court retained continuing jurisdiction to issue orders with reference to the construction or enforcement of this final judgment. From the briefs presented to the California Supreme Court it appears that the original parties to the New Jersey proceeding take opposing views as to the meaning of the decree.



The Department of Justice contends that the Bell Telephone System was prohibited from engaging in the business of leasing and maintaining facilities for private mobile communications systems, but was allowed a cut-off period of five years for serving those who were lessees within 45 days after the date of the judgment. Its view is that the phrase in subdivision (d) reading "the charges for which are not subject to public regulation" is descriptive of the fact stated, namely, that such charges *are not subject to public regulation.* The other parties to the consent decree are of the view that this phrase merely provides that if the charges are regulated by a state commission the telephone companies are not prohibited by the decree from continuing to furnish equipment and facilities for private mobile communications systems. Pacific was a party to that decree and would be bound by its terms.

In 1957 the FCC stated it had been unable to find any basis in the specific language of the consent decree to support the contention of the Department of Justice that it was the intent of that decree to prohibit the service, regulated or unregulated.

The California Supreme Court concluded thus: "In the proceedings before the state commission some of the petitioners argued that Pacific's motive in filing the proposed tariff 108-T was to avoid the consent decree. The commission held that there was no proof to that effect; that it would not take judicial notice of good or bad intentions; that if the federal court wished to bar such activities by Pacific even though subject to regulation, it would have made such a provision, and that there was nothing in the decree to prompt it to change its ruling that this service was utility service subject to its jurisdiction. No good reason appears why the decision of the commission in this respect should be disturbed." ■



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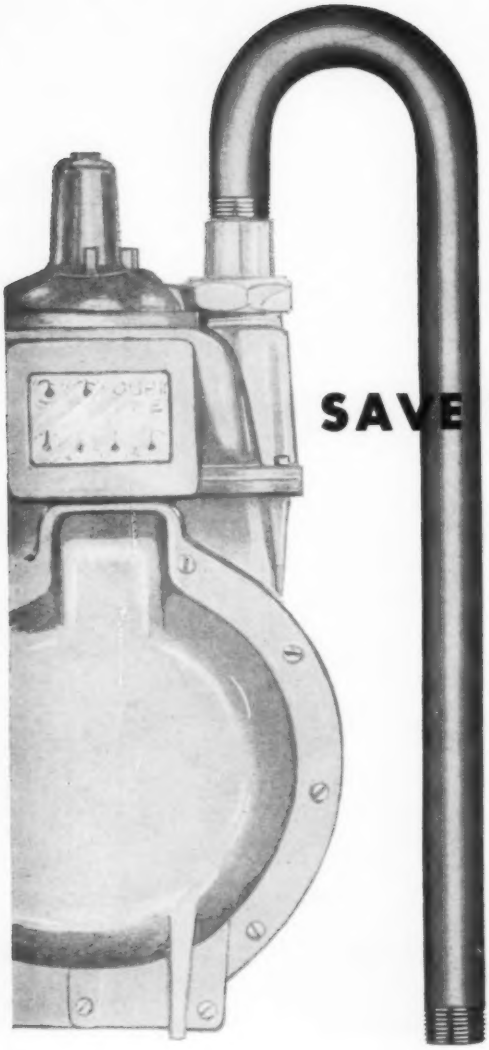

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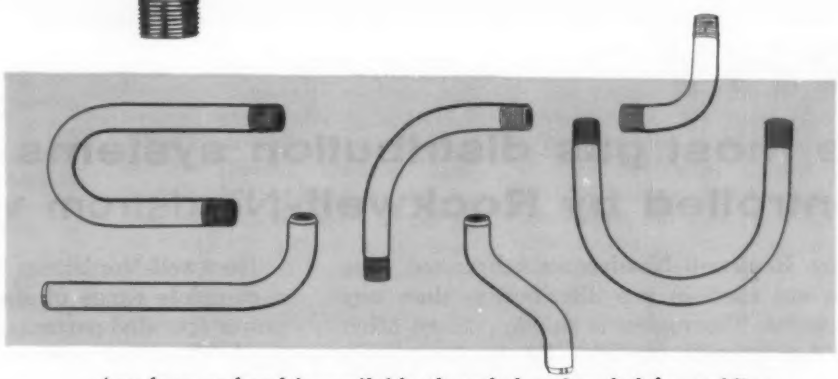

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TECHNICAL TRENDS

By GUY CORFIELD

Sonic oil well pump

The pumping rigs in an oil field, with the rising and falling beams and sucker rods, are a familiar sight. They may begin to disappear if a new development, the "sonic" oil well pump, proves to be as effective as present tests indicate. This is not a pump at the bottom of the well, or in any sense conventional. The pumping action is produced by longitudinal vibration of the entire string of tubing. The whole column of oil moves upward with each upward vibration, and by means of a series of check valves at the tubing joints, is prevented from falling back during the downward vibration. The vibration amplitude varies along the tubing length, the maximum movement being 0.30 to 0.50 in.

The tubing string is suspended by helical springs. The vibrations are imparted by a mechanical oscillator at the top of the string. The oscillator (not the tubing) is rotated at from 600 to 1200 rpm in accordance with the resonant frequency of the system. This oscillator is driven by the normal gas engine or electric motor power source.

Advantages claimed for this method of pumping are: low fabrication and installation cost; low operating cost; and ability to pump sand-laden and very low gravity oil.

The International Geophysical Year

The International Geophysical Year (IGY) is actually the 18 months beginning July 1, 1957. It has been planned on an international basis and the scientists of 70 countries are taking part. The general purpose is to probe, with simultaneous observations over an extended period and with the widest and most complete scope possible, the earth and its surroundings.

The time has been selected to coincide with the period of maximum solar activity with respect to sun spots and eruptions of great masses of flaming gas. This seems to occur about every 11 years. It blanks out radio communication and increases the rate of the earth's bombardment by cosmic particles. It is suspected that the sun's behavior has a direct relation to unusual weather phenomena such as earthquakes, tidal waves, storms, droughts and floods. It is consequently hoped that information can be gained that will at least help us to predict weather even if we cannot do much to control it. Beyond this the results and benefits can only be surmised but will undoubtedly be enormous—far in excess of the $600 million which the program is expected to cost.

Thought and action is stimulated by the development of rockets and the impending launching of the Satellite under Project Vanguard. This will permit an objective view of the earth from afar and beyond its protective atmosphere. Cosmic rays can be investigated. The overall turbulence and electric charges of the air masses can be observed. The actual shape and size of the earth can be measured more accurately. Also, of course, the problems and possibilities of space travel can be studied.

"Interface" geophysics will explore the absorption and radiation of the sun's heat as it causes water evaporation and melts and reforms the glaciers; also the development of the winds that distribute this heat by air movement and ocean surface currents, and transport rain clouds.

The surface of the earth will be more completely examined, particularly at the north and south pole areas where information is most lacking. Ocean currents and temperatures at all depths will be measured. Earth crust movements will be checked, and earth temperatures taken at the greatest available depths.

All these observations will be done on a planned and scheduled basis, with provision for rapid communication and special emergency programs if unusual disturbances are expected or suddenly encountered.

Solar Cells

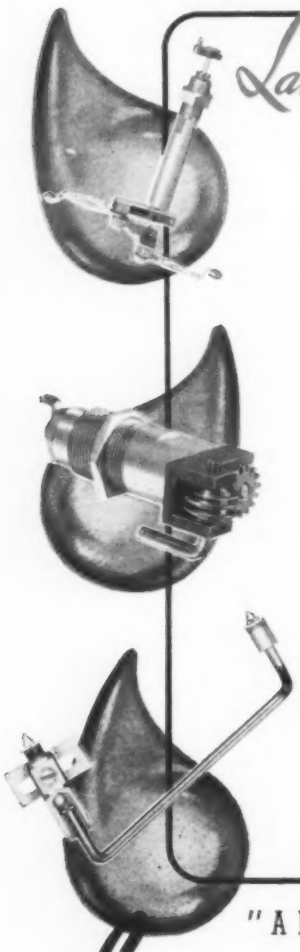
Practical developments are coming rapidly in the use of silicon solar cells for converting sunlight into electrical energy (see the December 1957 issue of this page). The Hoffman Electronics Co. is taking a leading part in this field, having formed a solar section of their Semiconductor Division at Evanston, Ill., and a semiconductor equipment design section at their Los Angeles laboratories. Another firm active in this development is International Rectifier Corp., El Segundo, Calif.

The cells are thin discs about an inch in diameter. They have a sunlight energy conversion efficiency of approximately 10 per cent, and produce from 10 to 30 milliwatts per square inch with a light intensity illumination of 5000 ft candles. The cost of manufacturing silicon solar cells has dropped from $1,000 to $60 per watt of electrical output, and a further reduction to $10 is expected.

A portable transistor radio, solar powered, is available at a cost of $100. Solar flashlights and highway warning flashers have been developed; they work from storage batteries which are charged during sunlight hours. Small electro-mechanical toys have been made, and a sun-powered clock is mounted on the Palm Springs (Calif.) Chamber of Commerce building.

Large assemblies of 300 to 400 cells have been used to power the flashing lights in a lighthouse, and a U. S. Forest Service radio repeater station at a remote location. An even more ambitious application has been put on the drawing board — a house with solar-cell shingles on the south exposure roof, which it is calculated could accumulate sufficient solar energy for its electrical requirements.

accuracy preserved in oil



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GAS CALENDAR

September

3- 5. Pacific Coast Gas Association Annual Convention—Multnomah and Benson Hotels, Portland, Oregon.

5. New Jersey Gas Association Annual Meeting—Spring Lake, N. J.

11. New England Gas Association Safety Conference — Sheraton Plaza, Boston.

12. New England Gas Association Commercial-Industrial Heating Division — Wachusett Country Club, West Boylston, Mass.

15-16. INGAA Annual Membership—The Roosevelt Hotel, New Orleans.

16-17. AGA 10th Annual Accident Prevention Conference — Sheraton-Seelbach Hotel, Louisville, Ky.

17-19. Southeastern Gas Association Annual Meeting—Sir Walter Hotel, Raleigh, N. C.

19. Oklahoma Utilities Association Gas Division Conference—Biltmore Hotel, Oklahoma City.

24-27. 7th International Gas Conference—Rome, Italy.

October

9-10. California Natural Gasoline Association 33rd Annual Fall Meeting—Huntington-Sheraton Hotel, Pasadena, Calif.

13-15. American Gas Association Annual Convention—Atlantic City, N. J.

15-16. Sixth Gas Measurement Institute (sponsored by University of Kansas and Southwest Kansas Petroleum Industry)—National Guard Armory, Liberal, Kan.

15-17. Wisconsin Utilities Association Electric & Gas Sales Operating Convention — Hotel Schroeder, Milwaukee.

20-24. National Safety Council—Chicago.

30. New England Gas Association Operating Division — Sheraton-Kimball, Springfield, Mass.

31. New England Gas Association Accounting Division—Statler Hilton Hotel, Hartford, Conn.

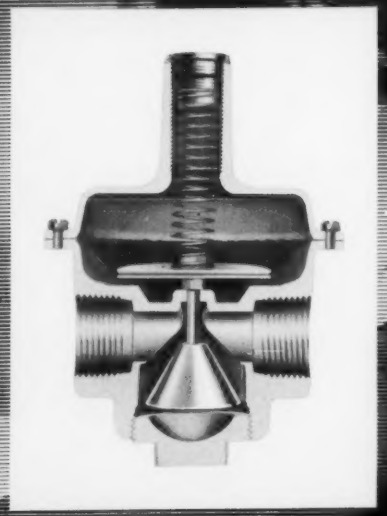
November

19-21. Mid-West Gas Association Gas Meter & Service School and Conference — Iowa State College, Ames.

December

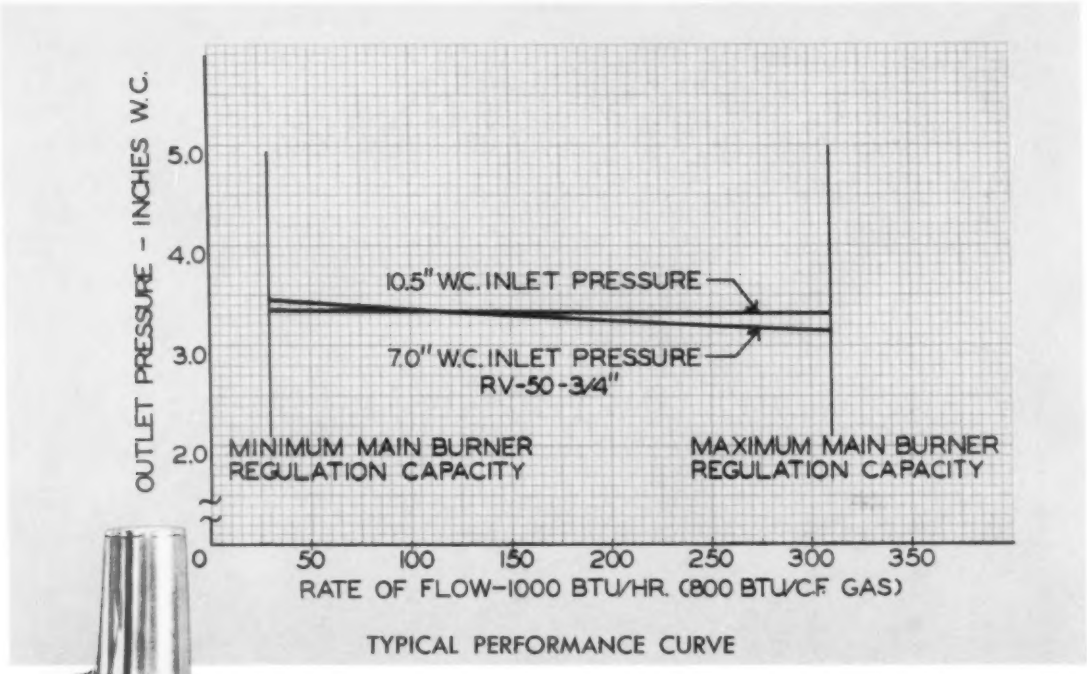
16. Rocky Mountain Gas Association Annual Meeting—Denver, Colo.

precision manufacturing means performance accuracy*

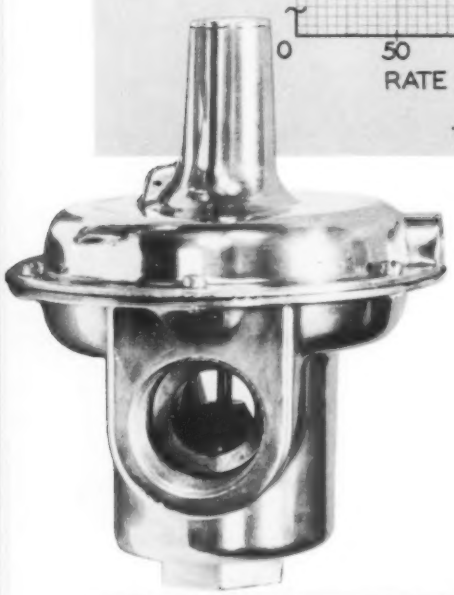


*Precision machining of cone and valve seat on the Maxitrol Straight-Thru-Flow regulators results in consistently accurate performance.

MAXITROL



TYPICAL PERFORMANCE CURVE



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WASHINGTON

By NEIL REGEIMBAL
GAS Washington Bureau

Federal controls not anticipated

TROUBLE in the Middle East continues to harry the Eisenhower Administration, but it is increasingly plain that the U. S. government will avoid invoking any new federal controls over production, prices, and transportation as long as all-out war can be avoided.

Present Washington thinking on federal controls over business and industry is that such controls are not needed for the simple reason that there are no shortages of any basic commodities. Oil and gas are in ample supply. Steel and other metals are eager for customers. Food is in abundance everywhere in the U. S. While there has been some stiffening of prices, both at the commodity level and at the consumer level, the slight upward trend is traceable more to the "scarcity psychology" of buyers, rather than to any genuine shortages. Gasoline, for example, has advanced somewhat in price, although stocks on hand are still at near-record levels.

But Washington bureaucracy is watching the foreign picture closely, day by day, and is fully prepared to invoke a program of extensive federal controls on a moment's notice. Thus, if we find ourselves embroiled in a big-league war, you can be sure that Washington will immediately start handing out the orders that impose strict controls over the types of steel products that steel mills may roll, over the uses to which line pipe may be put, the prices that sellers may charge, and the use that may be made of existing pipelines.

For example: At the Office of Oil and Gas, in the U. S. Interior Department, officials are worrying anew over how to move oil in volume from Texas to the East Coast in time of emergency. Tankers are vulnerable to submarines. The approach most talked about in government circles is to take over the long-distance pipelines for transport of oil. The Big Inch and Little Inch pipelines, for example, built during World War II, have a combined daily capacity of 435,000 bbl of crude oil. The Big Inch now carries natural gas. The Little Inch still moves oil. Both would carry oil in time of emergency, under present government plans.

The nation today is in a vastly superior position with respect to pipelines than it was 15 years ago. In addition to the lines serving the East Coast, there are numerous lines extending from fields of Texas, Louisiana, Oklahoma, and Wyoming into the Midwest. Almost all of these have come into existence since the early 1940s.

SUPPORTERS of gas legislation to free or at least ease federal controls are beginning to take a head count on the probable make-up of Congress next year as the industry's annual bout with a gas bill gets underway again.

Privately, the lawyers, politicians, and gas company officials who have led the fight for gas legislation are about convinced that there will have to once again be a new approach to the problem. And once again, the new approach will be an even milder bill than ever, they say.

The problem is the prospect that Congress in the 86th session—1959 and 1960 — will be even more "liberal" than ever. A whole host of conservative lawmakers who would support the free enterprise philosophy down the line are leaving Capitol Hill this year. In their place will come the "modern" politicians, who generally run from middle-of-the-road to left.

There's increasing talk around Washington that gas legislation as it has been known to date is dead for all time.

The best the producers can hope to get, these sources say, is a bill which will spell out the answers to some of the technical problems of how the FPC will exercise its unwanted control over producers. These are problems which the commission so far has been unable to solve.

They would include such headbusters as initial contract prices, how cost shall be used in setting prices, methods for price increases for both producers and pipelines, and the place, if any, of some indefinite escalation clauses.

There's an even more pessimistic group that believes now that the best the industry will ever get—if it gets anything—will be a measure exempting the small producers from federal control. This, they say, would become what it has long been touted to be: A compromise answer to the problems brought on by the Phillips decision.

Even some of the most bitter foes of gas producer decontrol, such as Sen. Estes Kefauver (D., Tenn.), have backed this legislation.

It would probably free producers who sell less than 2 MMcf in interstate commerce each year.

The belief is that the FPC would support this if nothing else seemed possible. The commission can show that most of the tremendous work load the Phillips decision placed on the agency comes from the marginal or small producers whose prices and operations indi-

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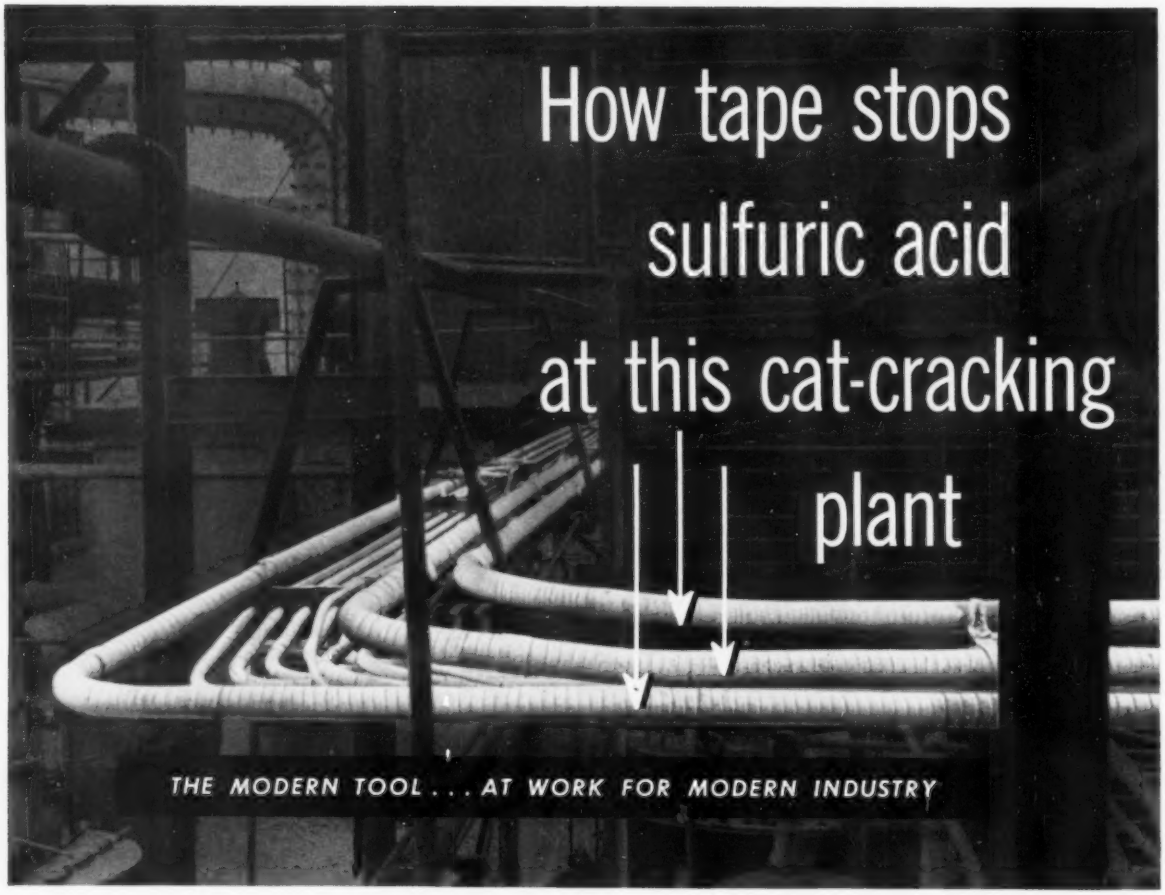

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By MARSHALL E. PARKER

Scrap steel ground beds still useful

IN the early days of cathodic protection, scrap steel pipe (of which most pipeline companies had a plentiful supply) was practically a standard material for ground beds. Later it was realized that lower electrochemical equivalent of cast iron—2 to 10 lb per ampere-year, as against 20 for steel—made it a more economical material. Still later the rising price of scrap and falling prices of other suitable materials, graphite and, still later, high-silicon cast iron, combined to make these materials virtually standard.

The scrap steel ground bed is not dead, however; it still has a field of application. This is in areas of high soil resistivity. Such a ground bed costs more than the conventional type in low resistivity soil; but it costs far less than the conventional type in high resistivity soil. So, if there is no choice, and you *must* build a bed in high resistivity soil, scrap steel may be your answer. And you need not worry too much about the high consumption of steel, because the high resistivity forces you to use so much area that the anticipated life is usefully long.

A recent example arose in western Canada. A major gas transmission line required drain points of approximately 18 amp at such intervals that two were badly needed in a long stretch where no soil could be found lower than 20,000 ohm-cm with power available or close enough to be considered. To discharge this current through conventional anodes would have required at least 35 or 40, at a cost which was practically prohibitive.

A considerable quantity of scrap 30-in. pipe was available, and fortunately there was a good supply of it at the two sites where the ground beds were needed. Dwight's equation gives, for a horizontal cylindrical anode

$$R = \frac{\rho}{2\pi L}\left(\log\frac{4L}{d} - 1 + \log\frac{L + \sqrt{2S^2 + 2L^2}}{4S} + \frac{2S}{L} - \frac{\sqrt{2S^2 + 2L^2}}{L}\right),$$

where R = resistance in ohms; ρ = soil resistivity in ohm-cm; L = length in cm; d = diameter in cm; and S = depth in cm.

In the case considered, L= length = 250 ft = 7620 cm; d = diameter = 30 in. = 76 cm; S = depth = 5 ft = 152 cm

Substitution of these values in the equation gives a value of 2.92 ohms for R. This permits the use of a (standard) 56-v rectifier to discharge the needed 18 amp. The usual excess capacity is not provided in this case; should coating deterioration demand greater current output, or if the calculations had proved incorrect, the resistance could have been lowered only by adding to the length of the anode bed.

In the actual construction of such a ground bed, the most important consideration is to take steps against the early segregation of large segments, with consequent loss of useful life. In the case described, the pipe sections—ordinary 40-ft joints—were pulled into the ditch with a winch truck; there is no economic justification for using the more expensive pipe-laying equipment. The joints were not aligned, but were merely pulled within a few inches of each other. Then each gap was bridged with

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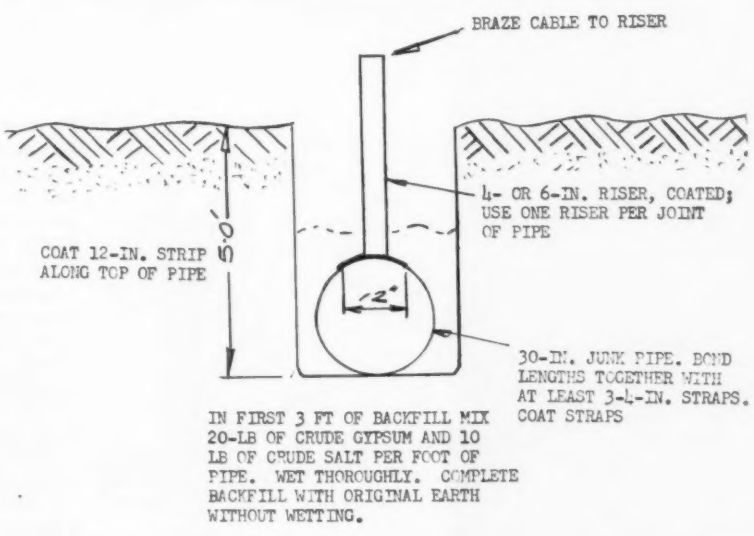
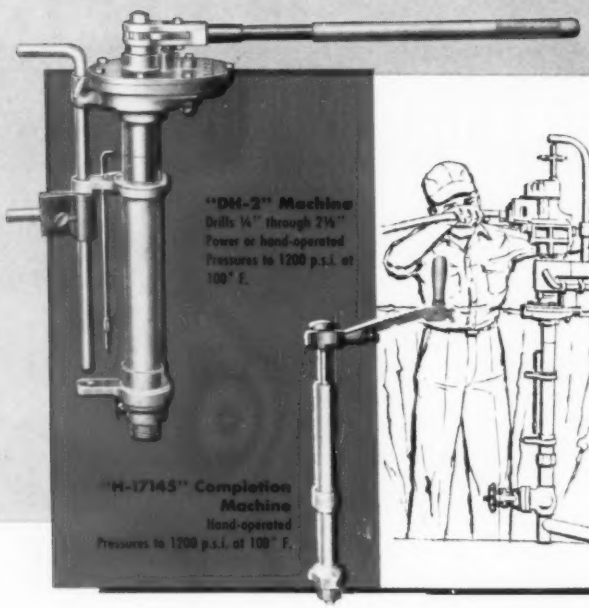

BRAZE CABLE TO RISER
4- OR 6-IN. RISER, COATED; USE ONE RISER PER JOINT OF PIPE
COAT 12-IN. STRIP ALONG TOP OF PIPE
5'
2'
30-IN. JUNK PIPE. BOND LENGTHS TOGETHER WITH AT LEAST 3-4-IN. STRAPS. COAT STRAPS
IN FIRST 3 FT OF BACKFILL MIX 20-LB OF CRUDE GYPSUM AND 10 LB OF CRUDE SALT PER FOOT OF PIPE. WET THOROUGHLY. COMPLETE BACKFILL WITH ORIGINAL EARTH WITHOUT WETTING.



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Pressures to 1200 p.s.i. at 100° F.

Drill the main

All Mueller drilling machines may be used to make main-to-service connections. Here the "DH-2" Machine is power-operated to drill the main through a tee. It may also be hand-operated. The "DH-2" drills only. Its companion machine, the "H-17145", is used for the following operations.

- Insert and extract completion plugs in tees, drilling nipples and line stopper fittings.
- Insert and extract stem and bushings in tees and valves.
- Insert and extract stems in tees and valves.
- Recondition body seats in valve tees and steel valves.

USE MUELLER® DRILLING MACHINES SAFELY UNDER PRESSURE!

Mueller "E-4", "EH-1", "D-4", "DH-2" and "T" Drilling Machines are usually used for making main-to-service connections by drilling through tees or stops.

But these machines have many other important applications and uses that do not always involve drilling. They are the basic machines used to perform the many different NO-BLO® operations.

These No-Blo operations, which were developed by Mueller Co. for the gas industry, permit service connections, transfer of services, repairs, replacements and a host of other tasks to be done in a controlled manner. All work is done safely and simply—under pressure—without escape or blowing of gas.

A few of these operations—and the machines that may be used—are shown.

"E-4" Machine
Drills ¼" through 1"
Hand-operated
Pressures to 500 p.s.i. at 100° F.

Stop-off lines

The illustration shows the handy "E-4" Machine used with a service line stopper fitting to stop-off lines for repairs, replacement, modification or transfer of services. This versatile machine will also perform all other No-Blo operations, such as:

- Drill the main through tees, stops, drilling nipples and line stopper fittings.
- Insert and extract completion plugs in tees, drilling nipples and line stopper fittings.
- Insert and extract stems and bushings in tees and valves.
- Insert and extract stems in tees and valves.
- Recondition body seats in valves tees and steel valves.
- Stop-off service tees.

Insert plugs

An especially convenient machine to use on smaller size fittings is the "T" Machine. Here it is being used to insert—or extract—a completion plug in a tee. Although the "T" Machine will perform all of the No-Blo operations, a companion machine, the "H-17045", may be used to speed completion operations.

Recondition seats

Here the "D-4" Machine is refacing the body seat of a curb valve tee. This is done under pressure without removing the tee from the line. It is also used for this operation on valve tees. Basically, the "D-4" is a larger version of the "E-4" and will perform the same No-Blo operations.

MUELLER NO-BLO ®

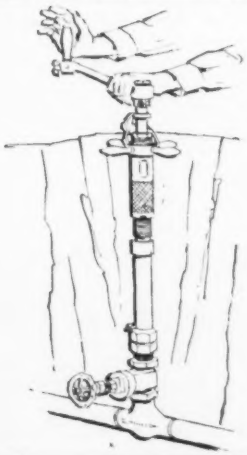
Contact your Mueller Representative or write direct for Booklet No. 5 for more information on the many applications and uses of Mueller No-Blo Products and Equipment.

MUELLER CO. since 1857 SERVING the Water and Gas Industries QUALITY

MUELLER CO.

DECATUR, ILL.

Factories at: Decatur, Chattanooga, Los Angeles; In Canada: Mueller, Limited, Sarnia, Ontario.



Extract stems

The balanced pressure "EH-1" Machine, which retains the "feel" of the tool even at high pressures, is shown extracting the stem from a No-Blo Steel Valve. The "EH-1" will perform the same No-Blo operations as the "E-4", but under much higher pressures.

Hundreds of Utilities Accepted Our Offer

"FREE, TEST THIS NEW HOME GAS FILTER at our expense"

The response has been overwhelming! It has proved to us the great need for this economical gas filter for installation right in the home.

It's the economical way to remove dirt, pipe scale, and other foreign matter from natural gas lines, and keep your customers' appliances operating efficiently.

Thousands are already in use . . . hundreds more are now on test. Why don't you take steps to minimize service calls by stopping dirt—the major source of clogged pilots—right in the home?

Accept our FREE offer

to give you a Staynew Home Gas Filter without obligation. Test it any way you like, and see for yourself its many advantages. All we ask is that you write us on your company letterhead so we are sure the filter goes only to authorized personnel. Address: Dollinger Corporation, 68 Centre Park, Rochester 3, N. Y.

REG. PROTECTOMOTOR U.S. PAT. OFF.

STAYNEW FILTERS

DOLLINGER

LIQUID FILTERS • PIPE LINE FILTERS • INTAKE FILTERS • HYDRAULIC FILTERS • ELECTROSTATIC FILTERS • MIST COLLECTORS • DRY PANEL FILTERS • SPECIAL DESIGN FILTERS • VISCOUS PANEL FILTERS • LOW PRESSURE FILTERS HIGH PRESSURE FILTERS • AUTOMATIC VENTILATION FILTERS • NATURAL GAS FILTERS • SILENCER FILTERS

Pioneer "Master Meter" Installation. American 500-B Ironcase Meters, one with Volume and Pressure Gage, record volume and pressure of gas delivered to a group of wells on Pioneer's line.

where the crops grow greener...

THANKS TO NATURAL GAS

From 18,000 irrigation wells over 10,000 miles of pipe carry water to irrigate nearly 3 million acres of Texas farm land in 23 counties in the Lubbock, Hereford and Amarillo areas served by Pioneer Natural Gas Company. Natural gas powers the well pump engines for less than half the cost of other fuels.

Irrigation has become a dominant factor in the agricultural economy of the area served, resulting in greater crop yields and profits. And, Pioneer's peak load is no longer in winter, but in summer.

Pioneer delivers gas from its irrigation feeder lines to groups of ten to twelve wells through a "Master Meter" installation. Lines from the "Master Meter" to the wells are owned by the farmers but delivery to each well is measured at the internal combustion engine.

American Ironcase Meters are used at "Master" and wellhead measuring points.

Wherever ability to withstand the elements and to produce sustained accuracy at low maintenance cost is required, you, too, can benefit from American engineering and American equipment for measurement and control.

Well Set Readings at each pumping operation are made by American 35B Ironcase Meters. Occasional differences between "Master" meter and "well set," readings represent line losses which are pro-rated among farm customers by Pioneer Natural.

Volume and Pressure Gage, (0 to 100 lb.) on 500-B Ironcase Meter and two Reliance Type HPR-10 Regulators at each Pioneer "Master Meter" installation, operate at 40 to 50 pounds pressure.

AMERICAN METER COMPANY

GENERAL SALES OFFICE: Philadelphia 16, Pennsylvania
Albany • Alhambra • Atlanta • Baltimore • Birmingham
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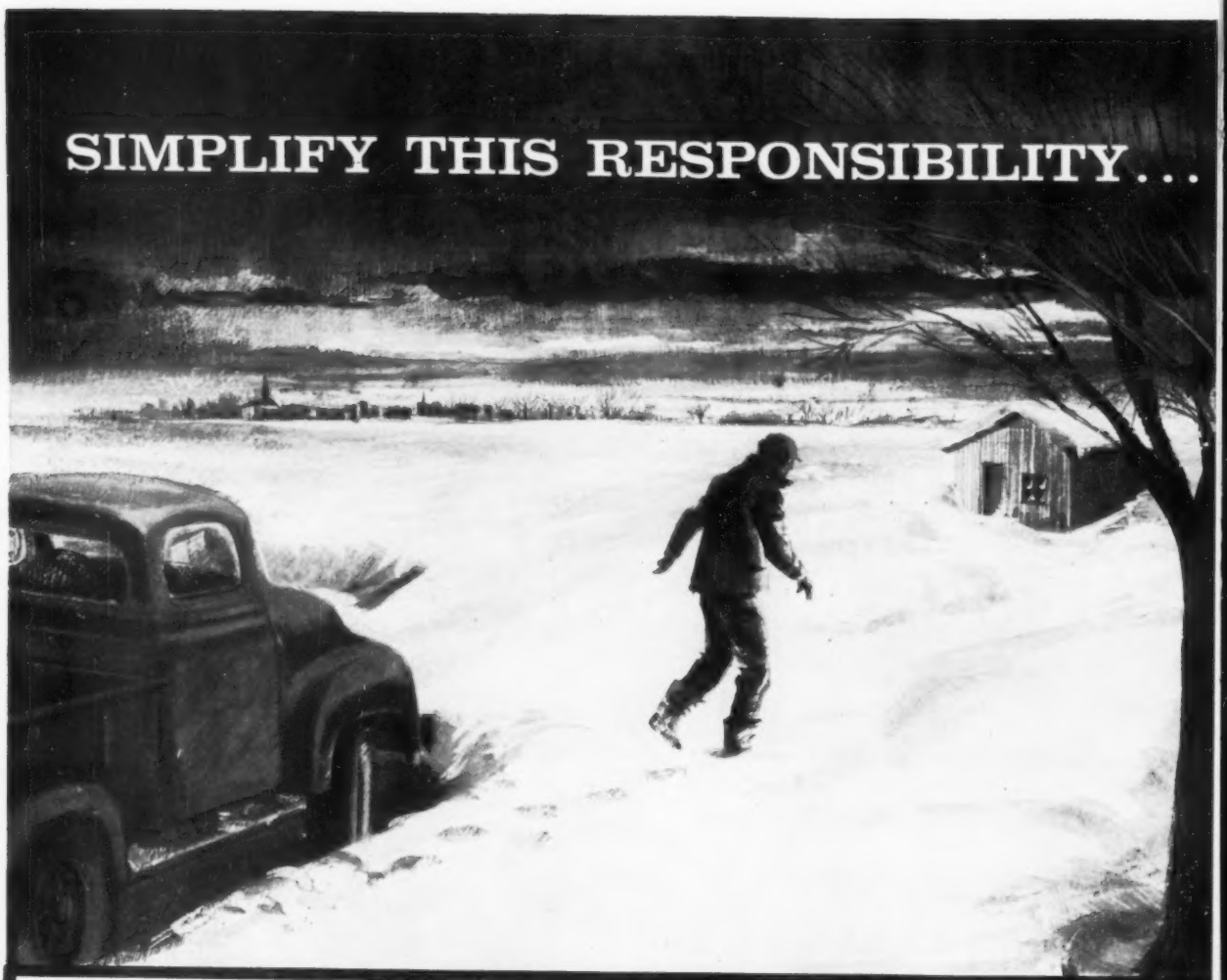
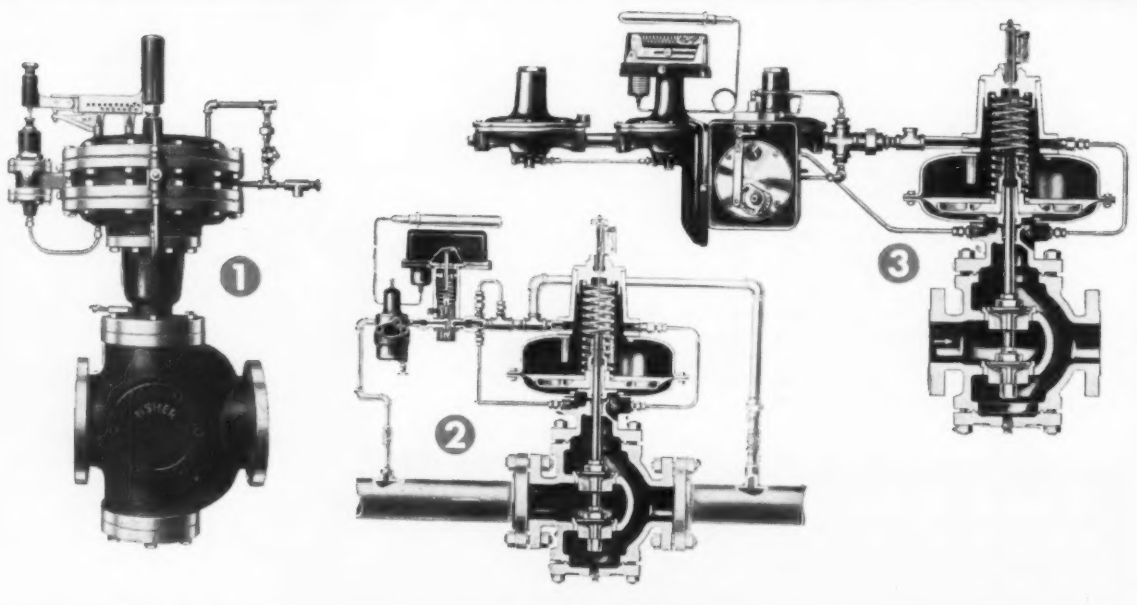
Kansas City • Los Angeles • Minneapolis • New York
Omaha • Pittsburgh • San Francisco • Seattle • Tulsa
Wynnewood, IN CANADA: Canadian Meter Company, Ltd.,
Milton, Ontario • Calgary • Edmonton • Montreal • Regina

SUPPLIERS TO THE GAS INDUSTRY for Ironcase, Tinned Steelcase, Aluminumcase and Welded Steelcase Meters

American-Westcott Orifice Meters • Instruments • Reliance Regulators • Apparatus • Valves

SIMPLIFY THIS RESPONSIBILITY...





to your customers and the gas industry

Keep Gas As The Best Fuel With FISHER PRESSURE BOOSTERS

YOU REPRESENT GAS SERVICE to your customers. The quality of your service greatly determines their opinion of gas as a fuel. Gas can be, and is, more economical—cleaner burning—faster. But, inadequate pressure at the time gas is needed most can change all that, giving competitive fuels the "foot in the door" they've been looking for.

KEEP GAS AS THE BEST FUEL, the top fuel. Install Fisher Pressure Boosters. They automatically anticipate peak loads by 30 to 90 minutes. Your customers always have correct pressure *instantly*. Without manual adjustments to make, you eliminate extra early morning man-hours and thousands of truck miles. By maintaining a minimum required pressure in low pressure systems, you cut "unaccounted for" gas losses.

NOW, choose from three basic types of Fisher Pressure Boosters for unequalled accuracy with pounds to pounds or pounds to inches service.

Write for your FREE descriptive catalog P30B . . . today!

1 Fisher-King Velocity Type Booster, Series 840

Ideal for intermediate pounds to pounds service. Increases own outlet pressure as flow through orifice downstream creates increased differential. Maintains constant pressure at low pressure point.

2 Fisher Temperature Booster, Series 832T

For pounds to pounds service. Increases own outlet pressure as temperature drops. Limits maximum delivered pressure even though temperature drops below ordinary values. Holds average pressure to minimum.

3 Fisher Time-Temperature Booster, Series 831LTC

For pounds to inches service. Automatically adjusts pressure in relation to temperature changes or pre-determined time intervals. Controls reduced pressure. Eliminates boosts during low load periods.

FISHER® Controls

SINCE 1880

FISHER GOVERNOR COMPANY

Marshalltown, Iowa / Woodstock, Ontario / London, England

CONTINENTAL EQUIPMENT CO. DIVISION, Coraopolis, Pennsylvania

Tool boxes are big enough to hold a full set of tools. Radiator shutters adjust to every kind of weather.

Constant full pressure behind breakers, tampers and other tools keeps them operating at top efficiency, speeds job progress.

All tanks are protected by heavy-A-frame.

Note stable mounting; standard as shown.

They're good, says Hood

43 JAEGER COMPRESSORS speed West Coast work for this pipeline contractor

Hood Construction Company is a major user of portable air compressors, handling pipeline projects throughout the Western states and Hawaii. Their preference for Jaeger is based on wide experience with the advantages of the Jaeger Air Plus Roto unit on construction work:

Higher efficiency (only 1700 rpm full load speed compared with 1800 rpm or more in other compressors) which directly saves fuel and wear.

More uniform air pressure maintained by instantaneous air delivery and smooth, stepless speed control.

Easy handling portability, full size tool boxes, 8-hour fuel tanks, and retractable pneumatic tired dolly wheel standard on all 2-wheel models in sizes up to and including 250 cfm.

Your Jaeger distributor will be glad to demonstrate the cost-saving advantages of these more modern compressors—Or let us send you Specification JCR8.

THE JAEGER MACHINE COMPANY

661 Dublin Avenue, Columbus 16, Ohio

Jaeger Machine Company of Canada, Ltd., St. Thomas, Ontario

Superior manufactures all sizes of meters from 80 to 7500 cfh.

Giving you an exact count of tomorrow's low flows . . . that's Superior Meter's criterion of performance. Low flows exist 20 out of 24 hours per day and, if unregistered, could cost as much as the meter in one year.

To maintain flow-sensitivity in its meters Superior Meter Company pays exacting attention to each detail of manufacture. From the flag arms, links and tangents to the valve arms and valves, the closest tolerances are held by modern machine tools with vastly improved precision capabilities. Diaphragms stay flexible, the result of highest quality materials seasoned and treated by a formula based on 40 years of experience. Step-by-step testing . . . taking advantage of the latest developments in quality control techniques . . . eliminates binds and friction . . . stops trouble before it starts.

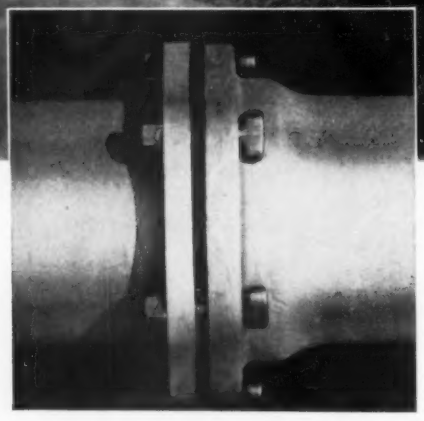
You buy wisely when you specify the meter that stays flow-sensitive, the Superior meter. The meter you buy today safeguards tomorrow's profits.

SUPERIOR METER COMPANY, INC.

19 West 50th Street, New York 20, N. Y.

A SUBSIDIARY OF NEPTUNE METER COMPANY

neptune



36" mechanical joint cast iron pipe gas main being installed in a Mid-western city.

CAST IRON®

Cast Iron Pipe Research Association, Thos. F. Wolfe, Managing Director, Suite 3440, Prudential Plaza, Chicago 1, Ill.

MECHANICAL JOINT cast iron

you're looking at the pipe of the future

no other pipe can match Cast Iron's dependability

In the next hundred years many changes . . . new products and developments . . . will make life a lot different than it is. But the cast iron gas mains laid today will still be serving efficiently.

That's a prophecy based on proof, not promise! 57 American gas companies are still using cast iron mains installed a century and more ago. Hundreds of others are over fifty years old.

And *modern* cast iron pipe, centrifugally cast, is even more rugged. Reassuring thought when you buy pipe — cast iron mains are in to stay and give economical, trouble-free service throughout their long life.

Specify cast iron . . . and be sure.

A FEW OF THE 57 GAS UTILITIES WITH CENTURY-OLD CAST IRON MAINS IN SERVICE

Citizens Gas Fuel Company, Adrian, Michigan—Niagara Mohawk Power Corp. (Gas), Albany, New York—Union Electric Company, Gas Division — Alton, Illinois — Atlanta Gas Light Company, Atlanta, Georgia.

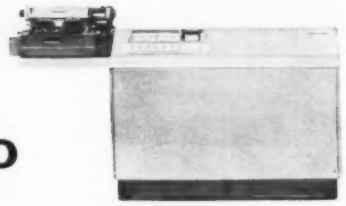
MODERN CAST IRON PIPE IS EVEN MORE EFFICIENT

- Centrifugally cast, it's tougher, stronger, more uniform.
- Standardized mechanical joints are bottle-tight under all gas distribution pressures . . . for all types of gas.
- Uniform wall thicknesses.
- Joint design allows deflection during and after installation.
- Service lengths and variety of standard fittings cut time and labor in congested undergrounds.

pipe FOR MODERN GAS DISTRIBUTION

TODAY'S GREATEST VALUE IN ELECTRONIC COMPUTERS!

ROYAL PRECISION LGP-30



Compare it, feature by feature, with the other computers in its class

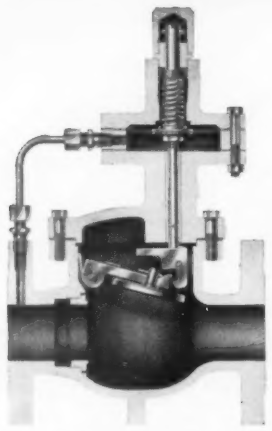
Feature	Computer A	Computer B	Computer C	Computer D	LGP-30	
Memory Size	220 words for data only	2160 words	1000 or 2000 words	84 words for data only	4096 words for data & program (either or both)	LARGEST CAPACITY IN ITS CLASS
Max. Speed Add Multiply	 20/sec. 4/sec.	 Comparable to LGP-30	 Comparable to LGP-30	 3/sec. 1/sec.	 Over 440/sec. Over 50/sec.	SPEED EQUAL TO MANY ROOM-SIZED COMPUTERS
Size	17 sq. ft.	6.5 sq. ft. plus table for typewriter.	45 sq. ft.	9.2 sq. ft. plus table for typewriter & control unit.	11 sq. ft.	COMPACT, DESK-SIZED, COMPLETELY MOBILE
Input-Output	Keyboard only — tape at extra cost.	Independent tape preparation at extra cost.	Extra cost peripheral equipment required.	Tape and typewriter for numerical input-output only. Independent tape preparation at extra cost.	Tape typewriter for alpha-numeric input-output standard equipment.	DELIVERED COMPLETE. NO ADDITIONAL EQUIPMENT NEEDED TO PREPARE DATA, PROGRAM OR REPORTS
No. of tubes	165	450	2,000	248	113	FEWER COMPONENTS MEAN LESS MAINTENANCE, FEWER CHECKOUTS
Voltage	220 V	110 V	220 V	110 V	110V	PLUGS INTO ANY REGULAR WALL OUTLET
Power	2.5 KW	3.0 KW	17.7 KW	1.65 KW	1.5 KW	NO SPECIAL WIRING OR AIR-CONDITIONING REQUIRED
Ease of programming & operation	Not alpha-numeric. No internal program storage.	Alpha-numeric at extra cost. 8 part instruction. Requires computer specialist.	Alpha-numeric at extra cost. Requires computer specialist.	Not alpha-numeric. No internal program storage.	Alpha-numeric. Complete internal program storage. Standard typewriter keyboard. Simplest command structure of all.	EASY TO PROGRAM AND OPERATE.
Cost Sale Rental	 $38,000 $1000/mo.	 $49,500 $1485/mo.	 $205,900 $3750/mo. up	 $55,000 $1150/mo.	 $49,500 $1100/mo.	LOWEST COST EVER FOR A COMPLETE GENERAL PURPOSE COMPUTER

Nation-wide sales and service. Trained staff of applications analysts. Library of subroutines available, plus programs for wide variety of applications.

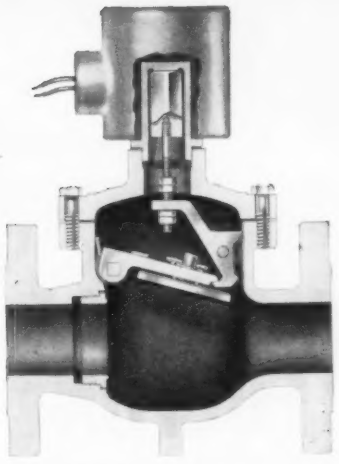
For further information and specifications on Royal Precision LGP-30, call your nearby Royal McBee office, or write Royal McBee Corporation, Data Processing Division, Port Chester, N. Y.

ROYAL McBEE

WORLD'S LARGEST MANUFACTURER OF TYPEWRITERS AND MAKERS OF DATA PROCESSING EQUIPMENT

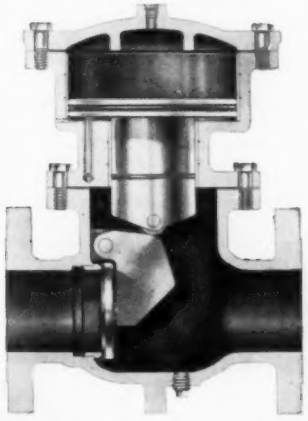


Model 1500H shown, is a high pressure shut-off valve which closes automatically and instantly when predetermined high pressure is reached. With addition of a fusible metal plug, valve can be furnished to shut off on overpressure and/or over-temperature. With control pressure above diaphragm, valve can be made into a low pressure shut-off valve. Combination high and low pressure shut-off also available.



Model 1700 shown, is a Solenoid operated valve normally energized to maintain valve in open position. On interruption of electric current valve closes instantly. Model 1800 Solenoid shut-off valve available to shut off gas instantly by applying electric current either automatically or through a "panic" button.

Instant action, sure and safe with Coppus Sentry® Valves



Model 3000 shown, is a piston operated valve, which opens instantly when pressure above the piston is released. Restoring the pressure above the piston closes the valve. The operating pressure above the piston can be obtained from the line or from an independent source of gas or liquid and can be automatically released or applied by instrument air or gas operated pilots or by use of a small three-way Solenoid valve.

Sentry Valves assure better protection of personnel and property. Instant, split second action with full flow, available in two basic types. Sentry Latch type valves for instant automatic closing; Sentry Piston type valves for automatic opening and closing.

The Latch type requires manual reset — the piston type can be opened and closed automatically.

Sentry Valves can be actuated by high or low pressures, by excessive temperatures, by excessive flow or electrically by use of a Solenoid.

Standard sizes — all Full-Flow — in steel or meehanite 1½" to 8".

To get more detailed information on this outstanding line of Coppus Sentry Valves send the coupon.

ANOTHER COPPUS "BLUE RIBBON" PRODUCT

COPPUS ENGINEERING CORPORATION
608 Park Avenue, Worcester 2, Mass.

Please send Bulletin 500.

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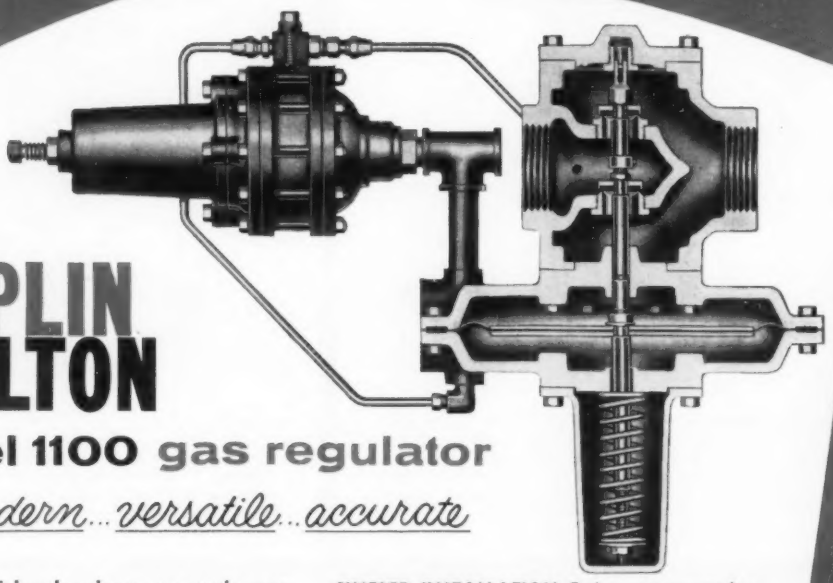


CHAPLIN FULTON

model 1100 gas regulator

modern... versatile... accurate

You can't buy, beg, borrow or steal a more versatile pressure regulator than MODEL 1100. Nor has traditional Chaplin-Fulton ruggedness, simplicity or accuracy been forgotten in this new modern design. Size —2" only, screwed, flanged 125 or 250 ASA.

WIDER APPLICATION Inlet Max.—400 psi. Outlet Range—1" to 150 psi.

GREATER CAPACITY 24,000 cfh at 10 psi to ounces; 114,000 at 100 psi. Body contoured for flow.

EASIER MAINTENANCE Regulator or pilot can be serviced without disturbing the other. Quickly accessible orifices in both, easily renewable.

SIMPLER INSTALLATION Only one connection required. No complicated pins or toggles to adjust.

You can standardize on MODEL 1100 for a wider range of your industrial, commercial or distribution installations.

ACCURATE CP MFG CO DEPENDABLE

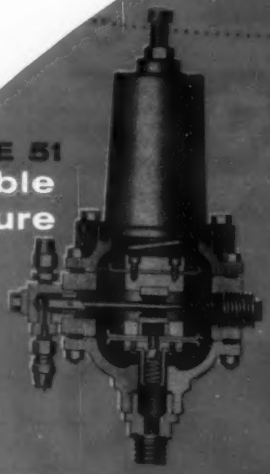
Write for bulletin 1100

Chaplin-Fulton

MANUFACTURING COMPANY

Pittsburgh 25, Pennsylvania

TYPE 51 variable pressure pilot



The heart of the MODEL 1100 assembly, insuring precisely accurate control over the complete flow range.

- Unitized construction—valve lever and orifice as a unit are removed from the outside, without disturbing balance of assembly. The likely trouble spot—the orifice—is placed outside where you can get at it quickly—no internal tubes to clog.
- Twin diaphragms remove as a unit.
- Internal relief unit—guards against overpressure.
- Spring unit—remove three screws to change springs.
- Built for service.
- Used for accuracy.

WON'T SMEAR ON MYLAR®!

Duralar

The only pencil

that **can't smear** on Mylar,
that **keeps a point** on Mylar,
that **erases** on Mylar.
Duralar drawings on Mylar **reproduce** perfectly, **microfilm** without loss and can even be **cleaned** with soap and water.

For a free sample

send coupon below with business letterhead. Specify whether you wish included a test sample of matte-surface Mylar tracing film. See for yourself how the sensational new Mars Duralar solves your drafting problems. And Duralar is available (pencils, leads and lead holders) in five special new degrees of hardness (K1 to K5).

Sold only at engineering and drawing material suppliers.

Registered trademark of E. I. du Pont de Nemours & Co., Inc.

Another first from

MARS

J. S. STAEDTLER, INC. HACKENSACK, N. J.

Gentlemen: Please send me FREE

☐ The revolutionary new DURALAR pencil
☐ Include a sample of Mylar film for testing the DURALAR pencil.

NAME _____ TITLE _____
FIRM _____
STREET _____
CITY _____ ZONE ___ STATE _____

service!

Hundreds of American gas companies are still using cast iron gas mains laid fifty years and more ago. Fifty five of these, in fact, have passed the century mark in service! What other pipe can approach, much less equal, this unique record? What's more, the modernized cast iron pipe, centrifugally cast today, is even tougher, stronger, more uniform.

"Service" is another name for cast iron.

The record proves it!

Service is Built Into Cast Iron

- Standardized mechanical joints are bottle-tight for usual gas distribution pressures... and for all types of gas.
- Centrifugally cast pipe is tough, strong and uniform.
- Joint design allows for deflection during and after installation.
- Service connections are easily made.
- Long life a matter of record.
- No shortages. Cast Iron Pipe is immediately available.

U.S. cast iron PIPE

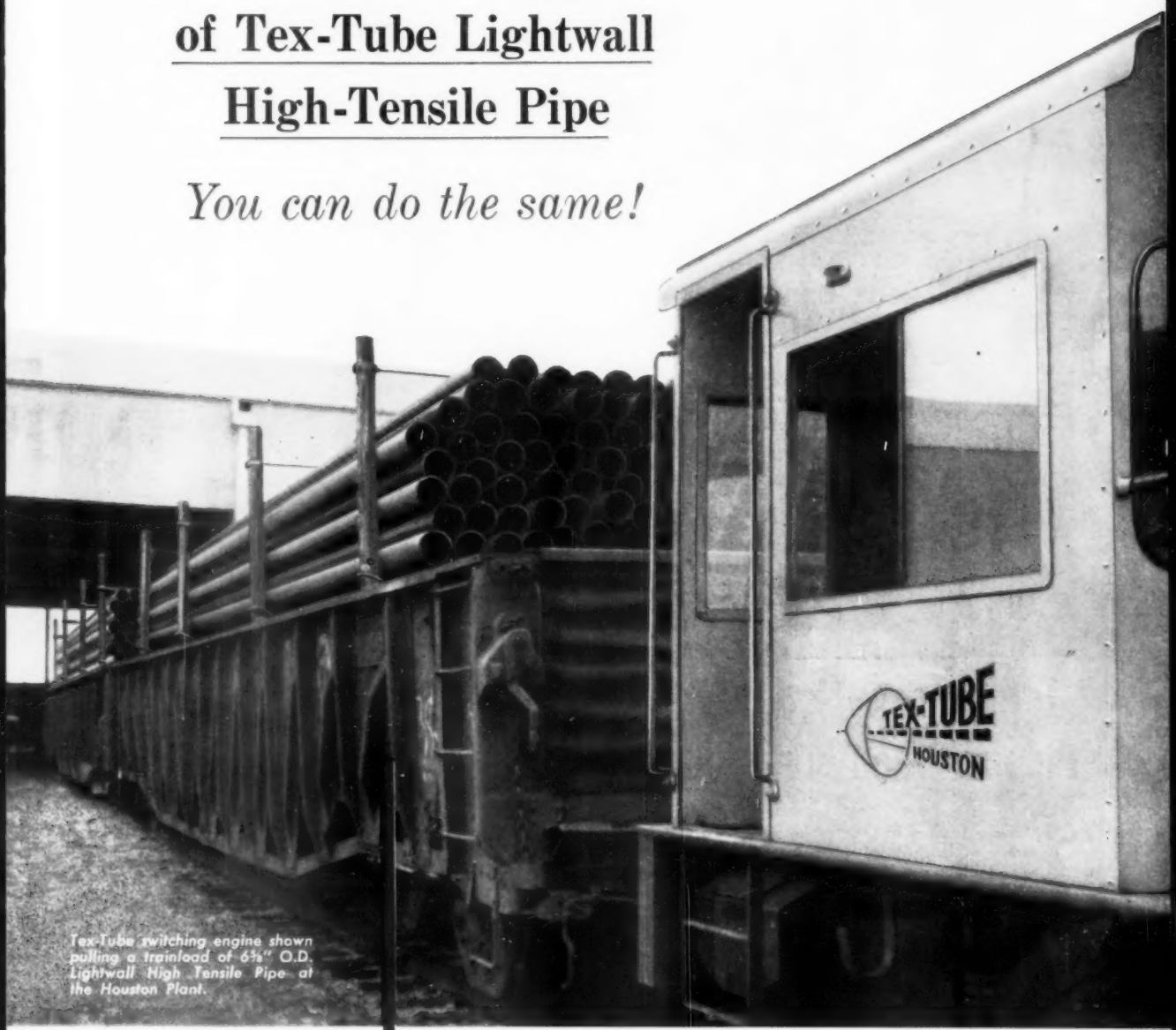
U. S. PIPE AND FOUNDRY COMPANY
General Office: Birmingham 2, Alabama

GEM Sponsor

A WHOLLY INTEGRATED PRODUCER
FROM MINES AND BLAST FURNACES TO FINISHED PIPE.

Our Customer
Saved $2407 per Mile of Pipe
on this Trainload
of Tex-Tube Lightwall
High-Tensile Pipe

You can do the same!



Tex-Tube switching engine shown pulling a trainload of 6⅝" O.D. Lightwall High Tensile Pipe at the Houston Plant.

TEX - TUBE, INC.

1503 NORTH POST OAK ROAD • HOUSTON, TEXAS

Sales Offices in Midland, Texas - Tulsa, Oklahoma
Baton Rouge, Louisiana

LICENSED BY THE AMERICAN PETROLEUM INSTITUTE

News about

B.F.Goodrich Chemical *raw materials*

Two-inch and six-inch pipe and fittings, as well as pipe supports at Florida Keys Electric Cooperative, Marathon, Florida, are made from Geon rigid vinyl. B.F.Goodrich Chemical Company supplies the rigid vinyl material only.

Pipe of Geon cures corrosion caused by ground currents

SEA water is used in the raw water system of this diesel generating plant, and electrolytic corrosion of the metal piping in the raw water system created quite a problem. Then pipe made from Geon rigid vinyl was installed and, after two years of operation, there is no corrosion problem in the piping handling the sea water.

The addition of a larger diesel unit to the plant now calls for six-inch pipe made from Geon rigid vinyl to handle the salt water used in cooling the diesels and lubricating oils, and for piping Bunker C fuel oil from the oil storage tanks to the plant. Even the pipe supports are made from Geon rigid vinyl.

Pipe of Geon is the logical choice wherever corrosion causes problems. And there are installation savings, too. Pipe of Geon is lightweight and easy to handle. Contractors like it. Can be readily joined by solvent welding or standard threaded fittings.

How can you benefit from pipe made of Geon rigid vinyl? Get information by writing Dept. LM-5, B. F. Goodrich Chemical Company, 3135 Euclid Avenue, Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.

B. F. Goodrich Chemical Company
a division of The B.F.Goodrich Company

B.F.Goodrich

GEON polyvinyl materials • HYCAR American rubber and latex
GOOD-RITE chemicals and plasticizers • HARMON colors

RUGGED CONSTRUCTION– Made from extra rugged, high strength steel or certified malleable iron, steel retainer ring and heavy end-nuts . . . shipped assembled, ready-to-use.

SUPERIOR GASKETS– Specially compounded for gas service, Dresser gaskets last as long as the pipe itself. They are continuously tested for plasticity, resiliency and low permanent set.

ABSORB PIPE DEFLECTION– Up to 6° pipe deflection at each joint! Vastly simplifies joining in cramped quarters, fittings 100% air-tested to provide a perfect, leak-proof seal . . . permanently!

Bury your service line problems for good...with DRESSER® fittings

• The design of Dresser Service Fittings provides for gasket sealing pressures greatly in excess of recommended line working pressures, with ample margin for permanent safety. The economy of their maintenance-free performance has been time-proved on millions of service lines across the country. Safe, simple and fast: corrosion-resistant Dresser Service Fittings let you bury your worries when you backfill the trench. For specifications, product properties, illustration of the *complete* line, and a summary of standard, current practices, send for your free copy of the Dresser Gas Service Fittings catalog form No. 5210.

***FROM MAIN TO FLAME:* A Superior Fitting for Every Need**

Bradford, Pennsylvania
Chicago
Houston
Philadelphia
New York
S. San Francisco
Toronto & Calgary

DRESSER
MANUFACTURING DIVISION
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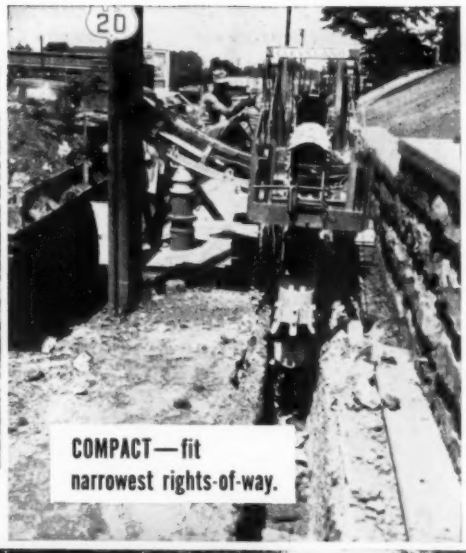

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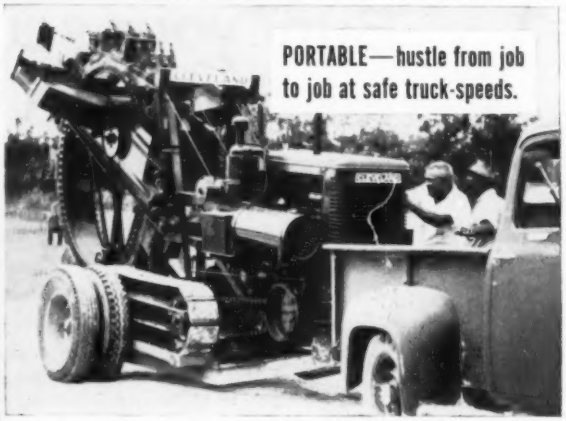

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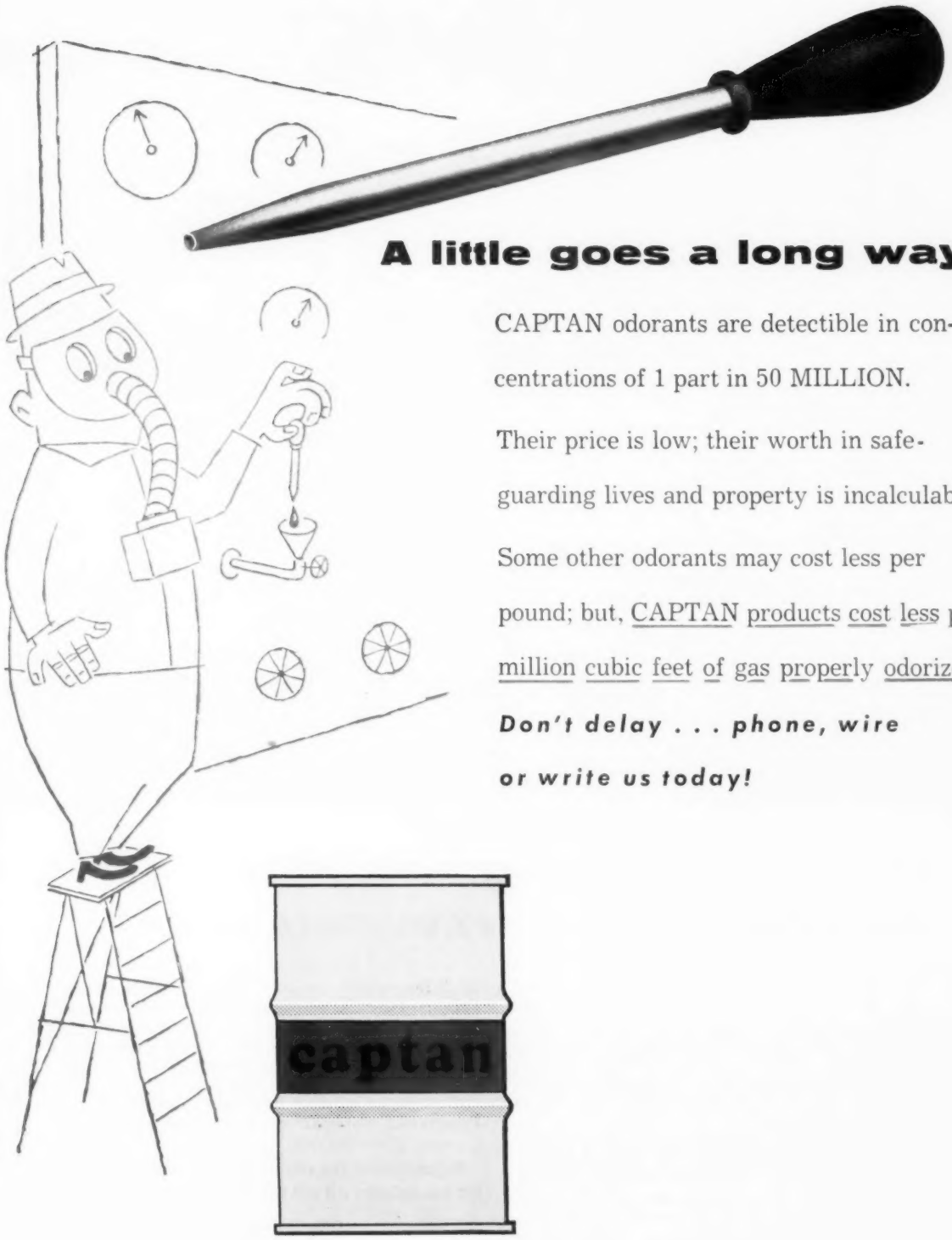

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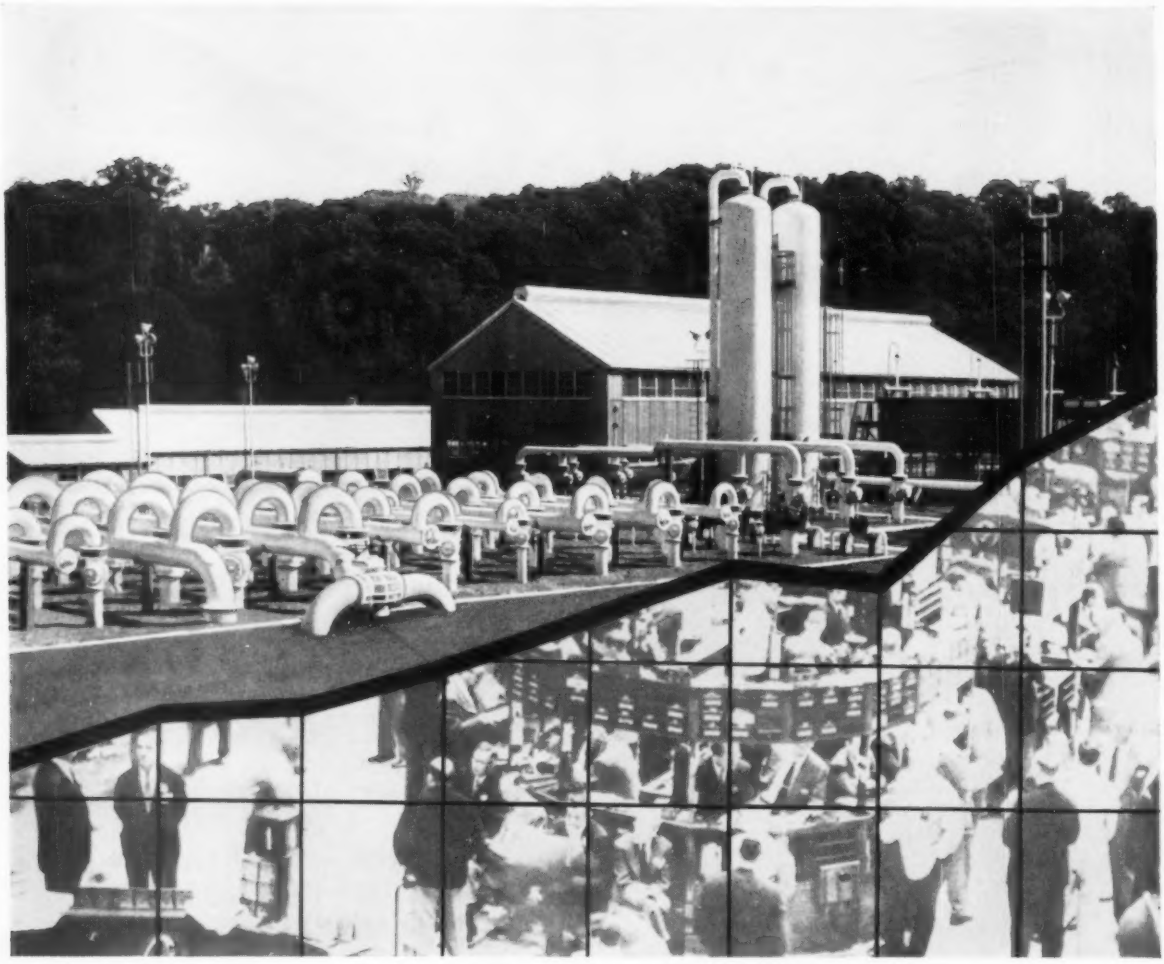

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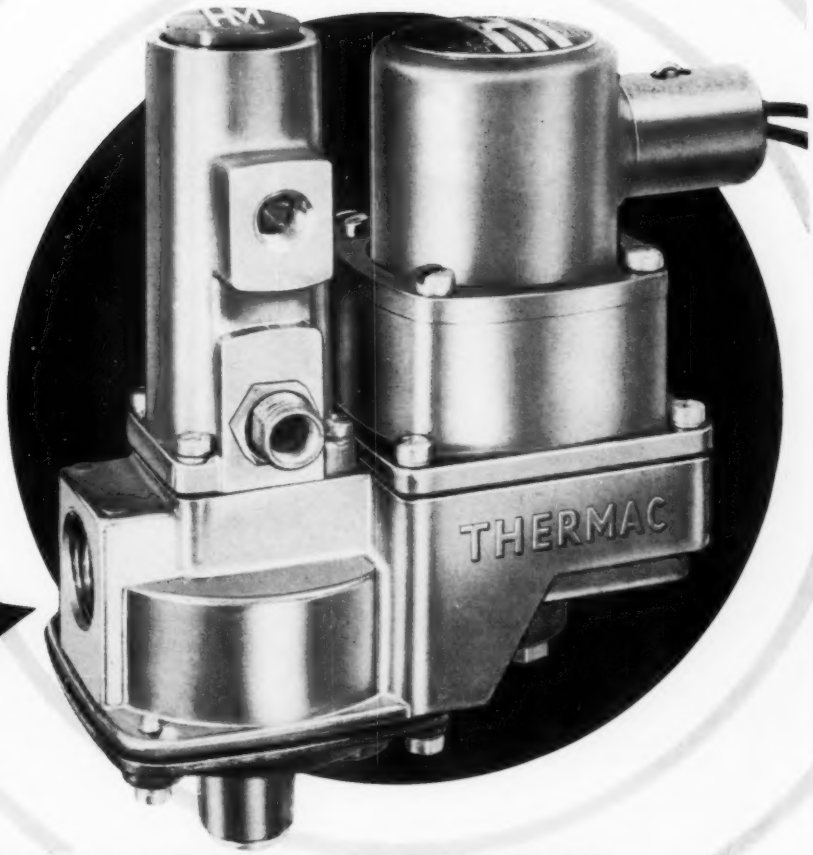

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GAS

SEPTEMBER 1958

Selecting flow equations for system network calculations

By G. G. WILSON and R. T. ELLINGTON
Institute of Gas Technology, Chicago

SELECTION of a flow equation to represent the flow behavior of gas in a given distribution system, and proper modification of this equation to account for deposits of foreign material in the system, are problems which have concerned gas engineers for many years. To date these problems have been resolved by the individual engineer on a trial-and-error basis, and all comparisons of flow equations have been based on the arbitrary selection of one equation as a standard.

Recently published data[4, 5] have firmly established the applicability of the flow relationships developed through correlation of experimental data by Stanton and Pannel[6] and Nikuradze,[3] and theoretically by Prandtl and von Kärman,[2] to the flow of natural gas in all commonly used diameters of steel pipe. These flow relationshps provide a sound theoretical and experimental basis for comparison of the accuracy of the various flow equations used in the industry. To make these comparisons, it was necessary to know the range of flow rates encountered for the various sizes of pipe and operating pressures in distribution systems. Since experimental data on the flow rates occurring in distribution systems were not available, values were obtained by analysis of digital computer solutions of network flow problems solved at IGT.

• Fundamentals of fluid flow in pipe

For isothermal flow of gas in horizontal pipelines, the general flow equation results from an energy balance in which kinetic energy effects are assumed to be negligible:

$$Q_b = C \frac{T_b}{P_b} \sqrt{\frac{1}{f}} \left(\frac{P_1^2 - P_2^2}{G\, T_{avg}\, Z_{avg}\, L} \right)^{0.500} D^{2.500} \qquad (1)$$

where:

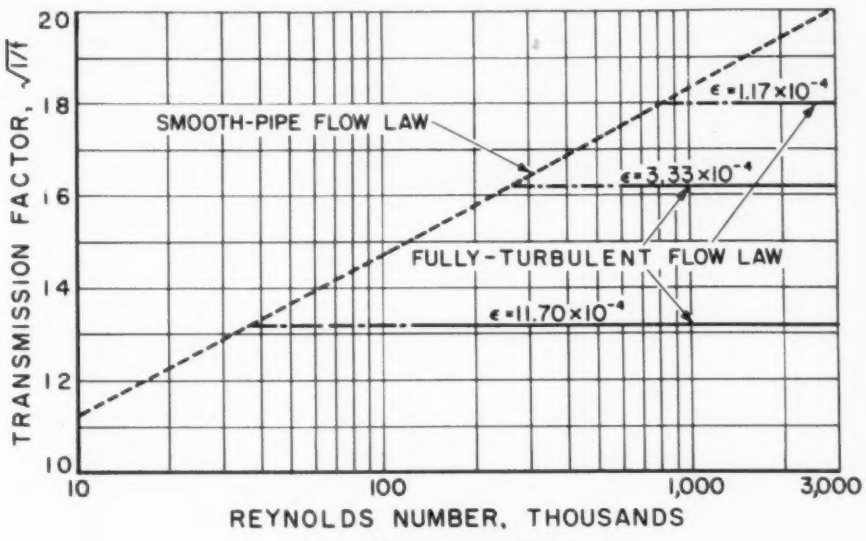

Fig. 1. Turbulent flow behavior.

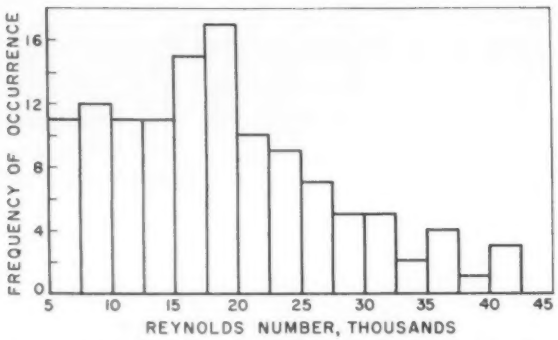

Fig. 2. Distribution of calculated Reynolds numbers in 4-in. pipe in two low-pressure distribution systems.

Q_b = gas flow rate, Scf per hour
C = a constant equal to 1.6156 when the terms in the equation are expressed in the units noted
T_b = base temperature, °R
P_b = base pressure, psia
P_1 = pressure at inlet of pipe section, psia
P_2 = pressure at outlet of pipe section, psia
D = internal pipe diameter, inches
G = specific gravity of gas
T_{avg} = average flowing gas temperature, °R
Z_{avg} = average compressibility factor of the flowing gas, dimensionless
L = length of pipe section, miles
f = friction factor, dimensionless

At pressures of less than 100 psig, the compressibility factor is nearly unity for natural gas, and this value is used in most of the flow equations employed in gas distribution work.

The general flow equation shows that for a given gas and operating conditions, the flow through a given section of pipe is directly proportional to the value of $\sqrt{1/f}$, the transmission factor. All of the commonly used flow equations, such as the Weymouth and Spitzglass, are derived from this basic flow equation by the substitution, for the transmission factor, of expressions based on laboratory or field flow data. Thus the accuracy of any given flow equation can be determined by comparing the transmission factor relationship on which it is based with the best available experimental data on transmission factors for commercial pipe used in gas distribution work.

Theoretical developments of von Kärman,[2] confirmed by careful experiments on the flow of fluid in pipe both in the laboratory[3, 6] and in the field,[4, 5] have shown that for turbulent flow the transmission factor depends on the Reynolds number and the "relative" roughness of the pipe wall, as shown in *Fig. 1*. The relative roughness of the pipe wall, ε, is defined as k/D, where k is the "effective" roughness of the pipe wall and D is the internal pipe diameter. The Reynolds number is a dimensionless term defined:

$$N_{Re} = DV\rho/\mu,$$

in which V is the average fluid flow velocity, ρ the fluid density, and μ the fluid viscosity, in consistent units. By appropriate substitution of terms, this expression can be transformed into one with the quantities usually dealt with in pipeline work:

$$N_{Re} = 0.011459, Q_b GP_b/\mu DT_b \quad (2)$$

in which the units of μ are lb/ft sec. Thus, for constant gas flow conditions through pipe of specified diameter, the Reynolds number is directly proportional to the gas flow rate.

As shown in *Fig. 1*, for any specified relative roughness the turbulent flow region is divided into two parts, a region in which the transmission factor depends only on the Reynolds number and is described by the implicit relationship:

$$\sqrt{1/f} = 4 \log N_{Re} \sqrt{f} - 0.6 \quad (3)$$

and a region in which the transmission factor depends only on the relative roughness of the pipe and is described by the relationship:

$$\sqrt{1/f} = 4 \log (3.7 D/k) \quad (4)$$

The transition between these flow regions is not sharply defined, but depends on the surface geometry of the pipe in some complex manner.[5] An error analysis of extensive data, obtained from carefully conducted flow tests on large diameter gas transmission pipe in the field, indicated that these data did not provide experimental justification for representing this transition region in any more refined manner than a simple extension of the fully turbulent

TABLE 1. ESTIMATED VALUES OF REYNOLDS NUMBER AT WHICH TRANSITION FROM SMOOTH-PIPE BEHAVIOR TO FULLY-TURBULENT BEHAVIOR OCCURS FOR STEEL PIPE WITH AN EFFECTIVE ROUGHNESS OF 0.7 MILS

Nom. Pipe Diameter, inches	*Schedule Number*	*Actual ID, inches*	$\sqrt{1/f}$ *at Intersection*	N_{Re} *at Intersection, thousands*
1	40	1.049	14.98	117
1¼	40	1.380	15.45	159
1½	40	1.610	15.77	189
2	40	2.067	16.15	249
3	40	3.068	16.84	385
4	40	4.026	17.31	520
6	40	6.065	18.02	816
8	40	7.981	18.50	1,100
10	20	10.250	18.94	1,450
12	20	12.250	19.25	1,760
16	20	15.376	19.64	2,250
20	20	19.250	20.03	2,880
24	20	23.250	20.36	3,530
30	20	29.000	20.74	4,490

TABLE 2. ESTIMATED VALUES OF REYNOLDS NUMBER AT WHICH TRANSITION FROM SMOOTH-PIPE BEHAVIOR TO FULLY-TURBULENT BEHAVIOR OCCURS FOR STEEL PIPE WITH AN EFFECTIVE ROUGHNESS OF 2 MILS

Nom. Pipe Diameter, inches	*Schedule Number*	*Actual ID, inches*	$\sqrt{1/f}$ *at Intersection*	N_{Re} *at Intersection, thousands*
1	40	1.049	13.15	36.1
1¼	40	1.380	13.63	49.1
1½	40	1.610	13.90	58.5
2	40	2.067	14.33	77.4
3	40	3.068	15.02	120.4
4	40	4.026	15.49	163
6	40	6.065	16.20	257
8	40	7.981	16.68	348
10	40	10.020	17.07	447
12	20	12.250	17.42	557
16	20	15.376	17.80	708
20	20	19.250	18.21	914
24	20	23.250	18.53	1,127
30	20	29.000	18.92	1,430

transmission factor lines to the smooth-pipeline.[5] This extension is shown by the dash-dot lines in *Fig. 1*. It is doubtful that significant conclusions can be drawn from any existing flow data in regard to the exact behavior of the transmission factor of commercial steel or cast iron pipe in the transition region.

On the basis of the preceding discussion, it is apparent that Equations 3 and 4 provide a logical basis for comparison of the relative accuracy of the various flow equations used for distribution system design calculations. To determine which of these equations should be used as a basis for comparison, it is necessary to establish the range of Reynolds numbers and effective roughnesses encountered in gas distribution system piping.

• Characteristic of fluid flow in gas distribution system piping

Roughness of commercial pipe. The effective roughness, k, in Equation 4 does not necessarily correspond to any direct physical measurement of the internal wall roughness of the pipe that can be made with existing instruments. The only significant data on the effective roughness of commercial pipe have been obtained by the substitution of experimentally determined transmission factors, obtained from measurements at sufficiently large flow rates that the transmission factor was independent of the flow rate into the fully-turbulent flow law. These calculated values of the effective roughness of commercial pipe in gas service range from 0.468 to 2.09 mils (thousandths of an inch), and seem to be independent of the pipe diameter for diameters from 2 in. through 36 in.[4, 5] The average value for clean steel pipe in transmission service is about 0.7 mils. Estimated values of the Reynolds number at which transition from smooth-pipe behavior to the fully-turbulent behavior occurs in the commonly used diameters of steel pipe with effective roughnesses of 0.7 and 2 mils, respectively, are given in *Tables 1 and 2*. These values are based on the assumption that the Reynolds number at which this transition occurs is given by the intersection of the smooth-pipe and fully-turbulent flow laws (*Fig. 1*).

A search of the literature on fluid flow did not reveal any calculations of effective roughness for cast iron pipe similar to those for steel, nor was any data found on the flow of fluids through cast iron from which effective roughness values could be calculated. Unfortunately, most of the data on flow of fluids through cast iron pipe dealt with flow of water through tuberculated pipe which had been in water service or through pipe internally coated with tar. There is only the general agreement of gas distribution engineers that the internal surface of cast iron pipe is significantly rougher than that of steel pipe.

Reynolds numbers encountered in distribution systems. To calculate the Reynolds number for flow in a given section of distribution pipe, all of the terms in Equation 2 must be evaluated. This is easily done with all but the flow rate and viscosity, and even the viscosity can be estimated if the gas composition is known.[1] Data on actual gas flow rates in distribution system piping are extremely meager because of the difficulties involved in making such measurements. However, calculated flow rates obtained from the solution of gas distribution system network flow problems for design purposes were considered representative of the order of magnitude of flow rates actually encountered in practice, so the results of several such solutions in the institute's files were used to determine their range.

Since the range of Reynolds numbers encountered in any given diameter of distribution system piping depends on the operating pressure, it was necessary to classify the systems according to operating pressure level: (1) low pressure, 4 to 10 in. wc; (2) intermediate pressure, 10 in. wc—2 psig; (3) medium pressure, 2-10 psig; (4) high pressure, 10-60 psig.

TABLE 3. RANGE OF CALCULATED REYNOLDS NUMBERS FOR THREE LOW-PRESSURE SYSTEMS

Nom. Pipe Diameter, inches	*Min. Significant N_{Re}, thousands*	*Max. N_{Re}, thousands*	*"Effective" Roughness Corresp. to Max. N_{Re}, mils*
2	4.4	13.7	9.25
3	5.5	26.2	7.72
4	6.2	41.5	6.73
6	10.9	63.2	6.98
8	20.7	54.5*	10.42
12	31.2	157	6.22
16	47.5	342	3.84
20	90.5	455	3.72
30	176.1	623	4.76

* Based on relatively small sample.

TABLE 4. RANGE OF CALCULATED REYNOLDS NUMBERS FOR TWO MEDIUM-PRESSURE SYSTEMS

Nom. Pipe Diameter, inches	*Min. Significant N_{Re}, thousands*	*Max. N_{Re}, thousands*	*"Effective" Roughness Corresp. to Max. N_{Re}, mils*
1.25	8.8	63.8	1.62
1.5	14.3	63.3	1.91
2	19.1	98.6	1.63
3	38.4	189.7	1.33
4	51.9	204.8	1.63
6	121.2	324.4	1.61

TABLE 5. RANGE OF CALCULATED REYNOLDS NUMBERS FOR ONE HIGH-PRESSURE SYSTEM

Nom. Pipe Diameter, inches	*Min. Significant N_{Re}, thousands*	*Max. N_{Re}, thousands*	*"Effective" Roughness Corresp. to Max. N_{Re}, mils*
1.5	21.1	165	0.67
2	30.1	235	0.74
3	49.2	391	0.68
4	81.7	548	0.66
6	166	733	0.76
10	300	1,500	0.66

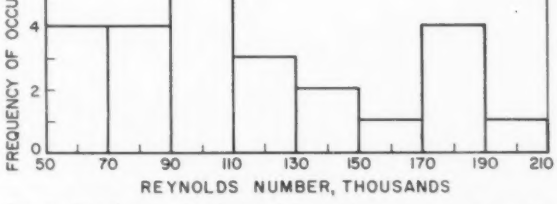

Fig. 3. Distribution of calculated Reynolds numbers in 4-in. pipe in two medium-pressure distribution systems.

It is necessary for a flow equation to accurately describe the relationship between pressure loss and flow rate in only those pipe sections in which a significant pressure loss occurs, so the lower Reynolds number encountered in each diameter of pipe was set as the flow rate required to give the lowest pressure loss per 1000 ft of pipe that was considered significant. The values selected for this lowest significant pressure loss were: low-pressure systems, 0.05 in. wc per 1000 ft; intermediate-pressure systems, 0.1 in. wc; medium-pressure systems, a difference of $(5.0 \text{ psi})^2$ in the squares of the inlet and outlet pressures (corresponding to a pressure loss slightly less than 0.2 psi); and high-pressure systems, a difference between the squares of the inlet and outlet pressures of $(10.0 \text{ psi})^2$ (corresponding to a pressure loss of approximately 0.2 psi at the 10 psi operating pressure level).

The range of these calculated Reynolds numbers for low-, medium- and high-pressure systems is shown in Tables 3, 4 and 5, together with an estimate of the effective roughness corresponding to transition from smooth-pipe to fully-turbulent behavior at the largest Reynolds number encountered in each pipe diameter. The roughness values were obtained by substitution of the transmission factor corresponding to the smooth-pipe law at these largest Reynolds numbers into the fully-turbulent flow law. The data on low-pressure systems were obtained from a suburban system containing 613 pipe sections, a small-town system containing 209 pipe sections, and a system of 89 pipe sections feeding a commercial area of a large city. Similarly, the data on medium-pressure systems were obtained from two small-town distribution systems, one of 134 pipe sections with an 8 psig source pressure, and the other of 113 pipe sections with a 10-psig source.

The data on high pressure systems were obtained from one suburban system of 420 pipe sections with a source pressure of 40 psig. No data is presented on intermediate-pressure systems because none was available in the institute's files at the time this study was made.

The distribution of Reynolds numbers for 4-in. pipe in two of the low-pressure systems is shown in *Fig. 2*, and for 4-in. pipe in the two medium-pressure systems is shown in *Fig. 3*. Note that the Reynolds numbers for 4-in. medium-pressure pipe are roughly 10 times those for 4-in. low-pressure pipe. The same type of distribution was obtained for all other diameters of pipe in all types of systems, with flow rates in most of the pipe sections corresponding to Reynolds numbers in the lower half of the range noted in *Tables 3, 4 and 5*.

It is interesting to compare the range of Reynolds numbers encountered in distribution system piping with the values of Reynolds number marking the transition from smooth-pipe behavior to fully-turbulent behavior for pipe with effective wall roughnesses of 0.7 and 2 mils, *Tables 1 and 2*. This comparison indicates that the range of Reynolds numbers encountered in practice is well within the flow region for which smooth-pipe behavior applies, for all diameters of pipe and all common distribution system operating pressures with pipe of effective roughness of 0.7 mils. The range of Reynolds numbers encountered in low-pressure systems also lies well within the range of application of the smooth-pipe law with pipe of effective roughness of 2 mils. The range of Reynolds numbers encountered in medium-pressure systems lies mostly in the range of the smooth-pipe law for this effective roughness, but the range of Reynolds numbers for high-pressure systems lies largely in the region in which the rough-pipe law applies. In general, the roughness values given in *Tables 3, 4, and 5* approximately correspond to the maximum values of effective roughness which can be possessed by distribution pipe of the given diameter, in a system of the specified operating pressure level, before fully-turbulent behavior will be encountered. Since data on the effective roughness of clean steel pipe have indicated that its roughness is usually less than 1 mil, flow of gas through clean

TABLE 6. TRANSMISSION FACTOR EXPRESSIONS FOR FLOW FORMULAS COMPARED WITH THE SMOOTH-PIPE FLOW LAW

Constant Transmission Factor

Flow Formula	*Expression for Transmission Factor*
Rix	$\sqrt{1/f} = 14.72$
Pole	Pipe Diameter $\sqrt{1/f}$
	$\frac{3}{4}$"–1" 9.56
	$1\frac{1}{4}$"–$1\frac{1}{2}$" 10.51
	2" 11.47
	3" 12.43
	4" and larger 12.90

Transmission Factor Expressed as a Function of Diameter

Flow Formula	*Expression for Transmission Factor*
Spitzglass	$\sqrt{1/f} = \left(\frac{354}{1 + \frac{3.6}{D} + 0.03\,D}\right)^{1/2}$
Weymouth	$\sqrt{1/f} = 11.19\,D^{1/6}$
Unwin	$\sqrt{1/f} = \left(\frac{227}{1 + 12/7\,D}\right)^{1/2}$
Oliphant	$\sqrt{1/f} = 13.0 + 0.433\sqrt{D}$

Transmission Factor Expressed as a Function of N_{Re}

Flow Formula	*Expression for Transmission Factor*
Panhandle "A"	$\sqrt{1/f} = 6.872\,N_{Re}^{0.0730}$
New Panhandle	$\sqrt{1/f} = 16.49\,N_{Re}^{0.01961}$
Blasius	$\sqrt{1/f} = 3.56\,N_{Re}^{0.125}$
Mueller	$\sqrt{1/f} = 3.35\,N_{Re}^{0.130}$
"Improved" Flow Equation	$\sqrt{1/f} = 5.18\,N_{Re}^{0.09091}$
Lees	$\sqrt{1/f} = \left(\frac{N_{Re}^{0.25}}{0.0018\,N_{Re}^{0.35} + 0.153}\right)^{1/2}$

Transmission Factor Expressed as a Function of N_{Re} and D

Flow Formula	*Expression for Transmission Factor*
Fritzsche	$\sqrt{1/f} = 5.145\,(N_{Re}\,D)^{0.071}$

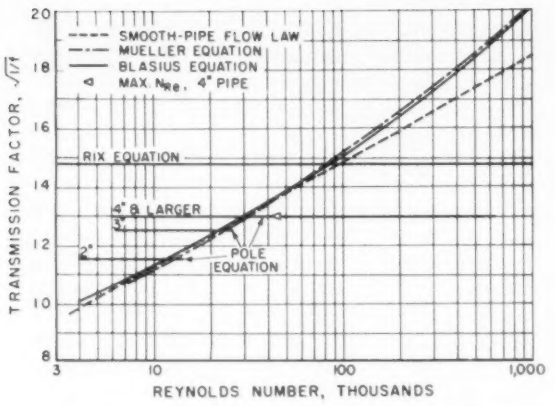

Fig. 4. Comparison of Rix, Pole, Blasius and Mueller equations with the smooth-pipe law.

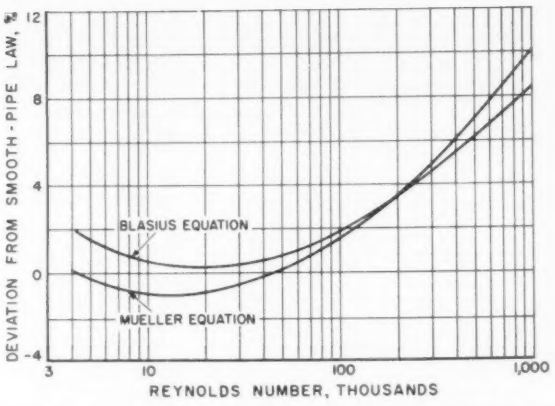

Fig. 5. Per cent deviations of Mueller and Blasius equations from the smooth-pipe law.

steel distribution system piping should best be represented by the smooth-pipe law. Hence, this flow law was used as the basis for comparison of the relative accuracy of flow equations for representing flow of gas through such piping.

• Comparison of gas flow equations with smooth-pipe law

The expressions for the transmission factor in the flow equations selected for comparison with the smooth-pipe flow law are presented in *Table 6*. In this table the equations are grouped according to the form of the transmission factor expression. The transmission factors of all of these flow formulas are compared with the smooth-pipe law in *Figs. 4 through 13*. Each comparison consists of two plots: first, the smooth-pipe law and the transmission factor expression for each flow equation as a function of Reynolds number, then the deviation of each transmission factor expression from the smooth-pipe law.

The flow formulas that have transmission factors which are functions of diameter give a constant transmission factor for all flow rates through pipe of a given diameter. These friction factor expressions were plotted as functions of Reynolds number by showing the transmission factor for each diameter as a horizontal line segment over the range of Reynolds numbers encountered in pipe of that diameter in distribution systems operated at the pressure levels for which the flow formula in question has been most commonly used. For the Pole and Unwin flow formulas use was assumed confined to low-pressure systems, for the Weymouth equation, medium- and high-pressure systems; and for the Spitzglass equation, low- and medium-pressure systems. The triangle pointing to the left across the Weymouth equation lines corresponds to the highest Reynolds number encountered in medium-pressure systems and the triangle pointing to the right corresponds to the lowest Reynolds number of significance in the high-pressure system analyzed. Similarly, the Fritzsche flow formula includes a diameter term and was considered to be most commonly used in low- and medium-pressure systems.

Fig. 4 shows that the assumption of a constant transmission factor as in the Rix formula is inadequate. The Pole formula (*Figs. 4 and 5*) represents a significant improvement and in fact corresponds reasonably well with the smooth-pipe law for pipe diameters of 2 to 4 in. in low-pressure systems. It is, of course, grossly conservative for pipe diameters larger than 4 in.

The deviations of the Spitzglass (*Figs. 6-9*) and Unwin (*Fig. 10*) equations from the smooth-pipe flow law were very similar. For 2- to 12-in. pipe, the transmission factor line segments for the range of Reynolds numbers encountered in low-pressure systems falls across the smooth-pipe flow law with the least deviation occurring at the higher flow rates, where the best fit is desirable. However, for 16- through 30-in. pipe, both of these flow equations give transmission factors considerably lower than the smooth-pipe law values. It is interesting that this trend of deviation from the smooth-pipe law at higher diameters is in accord with the opinion of many gas distribution engineers that the Spitzglass equation is extremely conservative for larger pipe diameters.

Transmission factors for the Weymouth equation are shown to be considerably lower than the smooth-pipe values for the smaller diameter pipe commonly encountered in medium- and high-pressure systems (*Figs. 6 and 7*). This result is in agreement with the fact that the Weymouth equation has been most widely used for transmission system flow calculations involving large diameter pipe operated at conditions where the fully-turbulent flow law has been found to apply. The conservatism of the Weymouth equation when used for flow calculations on high pressure gas distribution systems composed of clean pipe has been convincingly demonstrated by the results obtained in digital computer solution of two problems of this type. Both of these systems contained primarily 2- and 4-in. pipe of up to 25 years in use, both had distributed primarily natural gas, and one of the loadings for which each problem was solved was an actual maximum hour loading based on metered input data. The calculated results for both of these systems indicated that they should not have been able to carry the load that they had actually carried.

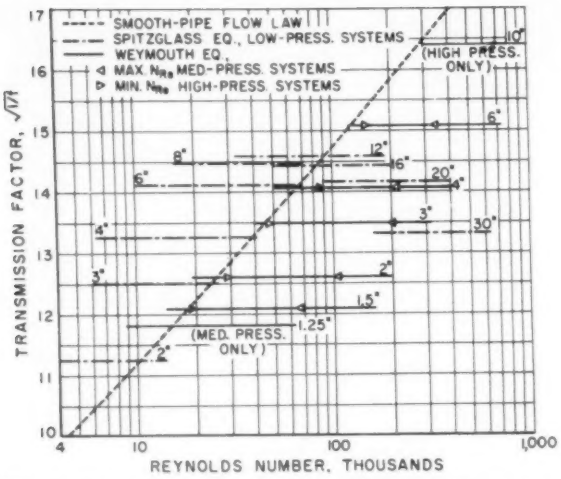

Fig. 6. Comparison of the Spitzglass and Weymouth equations with the smooth-pipe law.

In both cases it was necessary to multiply the calculated values of the difference of the squares in the inlet and outlet pressures for each pipe section by a factor of approximately 0.6, in order to obtain calculated pressures in the systems that checked reasonably well with measured pressures.

Even the general trend of the transmission factors for the Oliphant equation (*Figs. 8 and 9*) varies significantly from the trend of the smooth-pipe law. As a result, the transmission factor of this flow equation is grossly optimistic for small diameter pipe, 2 in. through 8 in., in low-pressure systems, and at the same time significantly conservative for pipe of 20-in. diameter and larger.

The rest of the flow equations included in this comparison have transmission factors that are functions of the Reynolds number. Both of the Panhandle equations deviate widely from the smooth-pipe flow law over the range of Reynolds numbers encountered in medium- and high-pressure systems (*Figs. 12 and 13*). This is not too surprising since both equations were developed for use in flow calculations for large diameter transmission piping operating at Reynolds numbers in the range of 5 to 20 million.

As might be expected, both the Blasius and Mueller equations, which are similar in form, compare to the smooth-pipe law in a very similar fashion (*Figs. 4 and 5*). Both compare quite closely to the smooth-pipe law in a range of Reynolds numbers from the lowest commonly encountered in gas distribution system work up to approximately 100,000, which is the range of Reynolds numbers encountered in low-pressure distribution system pipe of up to 8 in. diameter. At higher Reynolds numbers the deviation from the smooth-pipe flow law becomes quite marked. In general, the Blasius equation is a slightly better fit over this region than the Mueller equation.

An "Improved" flow equation, which is a modification of the Blasius equation, was developed at IGT under AGA Project NB-13 for gas transmission system flow calculations at flow rates where smooth-pipe flow behavior is encountered. This equation represents the smooth-pipe flow law with a deviation of ±1 per cent for Reynolds numbers from 60,000 to approximately 7,000,000 (*Figs. 12 and 13*). It is not particularly suitable for flow calculations in low-pressure distribution systems, but should give reasonably good results in medium- and high-pressure systems except for the smallest pipe sizes used in these systems. Lees flow formula gives an excellent representation of the smooth-pipe flow law over the range of Reynolds numbers of interest in gas distribution system work (*Figs. 10 and 11*), and expresses the transmission factor as a Reynolds number function that can readily be substituted into the general flow equation. However, the form of the equation that results is quite cumbersome and not suitable to expression in the convenient form: $\triangle P^2 = KQ^n$, where K has the nature of a resistance factor for each pipe section, and n is a constant. For this reason, this flow equation is not at all suitable for use in the solution of distribution system network flow problems.

The only flow equation included in this presentation with a transmission factor that is a function of both Reynolds number and pipe diameter is the Fritzsche equation. Transmission factors for this equation are significantly lower than the smooth-pipe values for all pipe diameters (*Figs. 10 and 11*) with the maximum deviation occurring at the higher flow rates, where the best fit is desirable.

In summary, these comparisons indicate that no one flow formula in current use can be relied upon to accurately represent flow of gas in clean steel distribution pipe over the entire range of distribution system pressures commonly used, except the Lees formula, the form of which is too cumbersome for practical use. Reasonably accurate results can probably be obtained in low-pressure system calculations by use of the Pole formula for pipe diameters up to 4 in., and the Spitzglass and Unwin for pipe diameters up to 12 in. The Mueller and Blasius equations should give acceptable accuracy for low-pressure calculations involving pipe up to 8 in., and medium-pressure piping up to 12 in. in diameter. However, the only practical flow equation that could be expected to give relatively realistic results for flow calculations involving larger diameters of medium-pressure system pipe, and 2-in. and larger pipe in high-pressure systems, is the Improved equation.

• Proposed flow equation for distribution system use

Examination of the accuracy of the flow formulas now in use for distribution system flow calculations has shown that none of these flow formulas can be expected to give accurate results over the entire range of pipe diameters, operating pressure levels and flow rates encountered in distribution system operations. In particular, there is no one flow formula which can be expected to give accurate results over the range of commonly encountered diameters and flow rates in medium- and high-pressure distribution systems. Accurate results can be obtained only by combination of two of the existing flow formulas, such as the Mueller or Blasius and the Improved.

Since it would be most inconvenient to use two different flow formulas, it is desirable to have a single equation which accurately represents the flow over the entire range of pipe sizes and operating conditions encountered in any given distribution system. It was found that such a flow equation could be developed by use of a different combination of constants in a transmission factor expression of the form: $\sqrt{1/f} = aN_{Re}{}^{b}$, where a and b are constants. This is the type of transmission factor expression on which the Mueller, Blasius, Improved, and Panhandle formulas are based. With a = 4.169, and b = 0.100, a fit of the smooth-pipe flow law was obtained with deviations within ±1 per cent for Reynolds numbers from 25,000 through 1,600,000, within 2 per cent from 16,000 through 3,000,000, and with a maximum deviation of 7.62 per cent at 4000, the smallest Reynolds number of significance for low-pressure distribution system calculations (*Figs. 14 and 15*). The flow formula obtained by substitution of this transmission factor into the general flow equation is:

$$Q_b = 0.0643 \frac{T_b}{P_b} \left[\frac{(P_1^2 - P_2^2)}{T_{avg} Z_{avg} L} \right]^{0.9} \frac{D^{2.3}}{G^{0.9} \mu^{0.1}} \qquad (5)$$

where the units of Q_b and L are Mcf/hr and feet, respectively.

It is believed that this equation will prove particularly suitable for intermediate-, medium-, and high-pressure gas distribution systems, and that it can also be used without introducing significant error for low-pressure distribution system calculations. When it is placed in the form commonly used for network flow calculations, it becomes:

$$\Delta (P^2) = K Q_b{}^{1.80}$$

where:

$$K = 2.088 \left(\frac{P_b}{T_b} \right)^{1.80} \frac{G^{0.80}}{D^{4.80}} \mu^{0.20} T_{avg} L \qquad (6)$$

As a check on the utility of this flow equation, it was used to obtain a repeat solution of one of the two high-pressure gas distribution systems that was poorly represented by the Weymouth equation, as previously noted. The interconnected portion of this system consisted of 165 pipe sections fed from three regulators, each set at 32 psig. The comparison

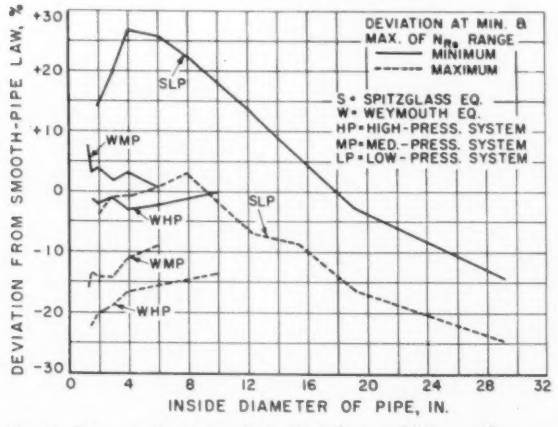

Fig. 7. Per cent deviation of the Spitzglass and Weymouth equations from the smooth-pipe law.

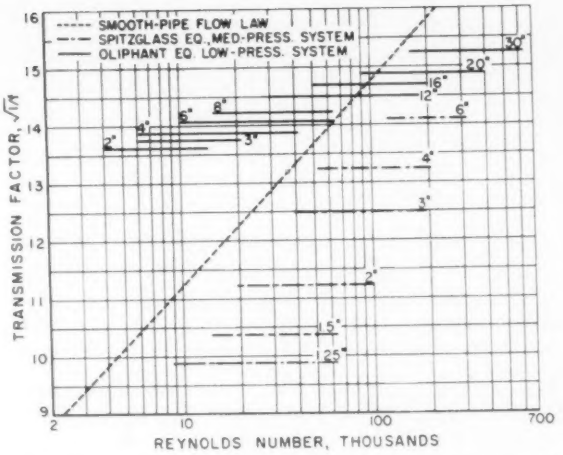

Fig. 8. Comparison of Spitzglass and Oliphant equations with the smooth-pipe law.

between observed and calculated pressures at five scattered points throughout the system was:

Observed pressure, psig	*Calculated pressure, psig*
23	22.5
21	20.0
16	14.4
9	9.8
6.5	6.1

The close agreement between these values shows that this distribution system was very well represented by the proposed flow equation.

The only major disadvantage of a flow formula of this form, as compared to the more conventional square-law form, is that it significantly increases digital computer time for solution of net work flow problems. It does not affect the time required to prepare a problem for solution or to enter it into the computer, but limited experience with a new computer program which can handle a flow formula of this form indicates that the computer time requirement for a solution will be increased approximately 75 per cent. On the other hand, this flow equation is ideally suited for use in the solution of network flow problems with a McIlroy analyzer, since its form can be made identical to that of the electrical flow formula that represents the flow of electricity through the fluistors used in this analyzer.

• Modification of flow equations for cast iron or dirty pipe

Since most cast iron pipe is used in low-pressure distribution systems, and the range of Reynolds numbers encountered in these systems is relatively low, the smooth-pipe flow law may accurately represent the flow through these cast iron low-pressure systems even though the internal surface roughness of cast iron pipe is considerably greater than that of steel. The approximate effective roughnesses that must be exceeded in each diameter of cast iron low-pressure system pipe before fully-turbulent flow would be encountered are the values given in *Table 3*.

Extensive and accurate data on flow of gas through clean cast iron pipe are needed before the applicability

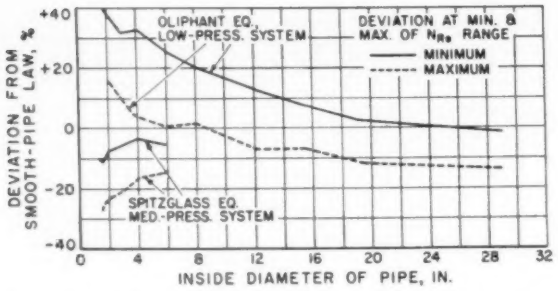

Fig. 9. Per cent deviation of Spitzglass and Oliphant equations from the smooth-pipe law.

of the smooth-pipe flow law, and hence of the flow equation presented in this article, can definitely be established for low-pressure cast iron distribution system calculations. A rough check on the applicability of the proposed flow equation to cast iron systems can be obtained by using it in the digital computer solution of an intermediate-pressure, relatively clean, cast iron distribution system flow problem based on an actual loading during a pressure survey.

Accurate flow calculations are particularly difficult for older distribution piping containing deposits of various types. For such systems, use of the flow formula presented in this article will serve to indicate the maximum possible capacity of dirty systems, and the actual capacity will be somewhat less. For many design purposes the actual capacity of the dirty piping is not sufficiently less than the maximum to seriously alter the design. If more accurate results are desired, it is necessary to compare pressure losses, estimated by use of some flow formula, with the results of a pressure survey, and then to modify the resistance factors of some of the pipe sections in the network until reasonable agreement between the two is obtained.

If the distribution system design engineer has reason to believe that the primary effect of the dirt in the pipe is to reduce its cross-section and hence its effective diameter, a rational approach is to modify the resistance factors given by the flow formula presented in this article. When suitable resistance factors have been obtained, they can be translated in terms of effective diameters of the pipe.

On the other hand, the distribution system design engineer may have reason to believe that the primary effect of dirt and deposits in the pipe is to roughen its internal surface. In this case, if pressures calculated by use of the proposed flow equation are significantly higher than the measured pressures, it will indicate that the pipe wall roughness was great enough in a significant number of pipe sections to induce fully-turbulent flow.

The Weymouth and Panhandle "A" equations are commonly used in transmission pipeline calculations, where fully-turbulent flow is frequently encountered. A comparison of the transmission factors of these flow equations with the fully-turbulent flow law for three effective roughnesses is shown in *Fig. 16*. Since the transmission factor of the Panhandle "A" equation depends on the Reynolds number, it was plotted as a function of pipe diameter by showing it as a vertical line segment for each diameter. The range of transmission factors for each of these line segments corresponded to the range of Reynolds numbers encountered in pipe of the specified diameter in the high-pressure distribution system from which calculated flow data were available.

This comparison shows that the Weymouth equation is a reasonably good approximation to the fully-turbulent flow law for pipe with an effective rough-

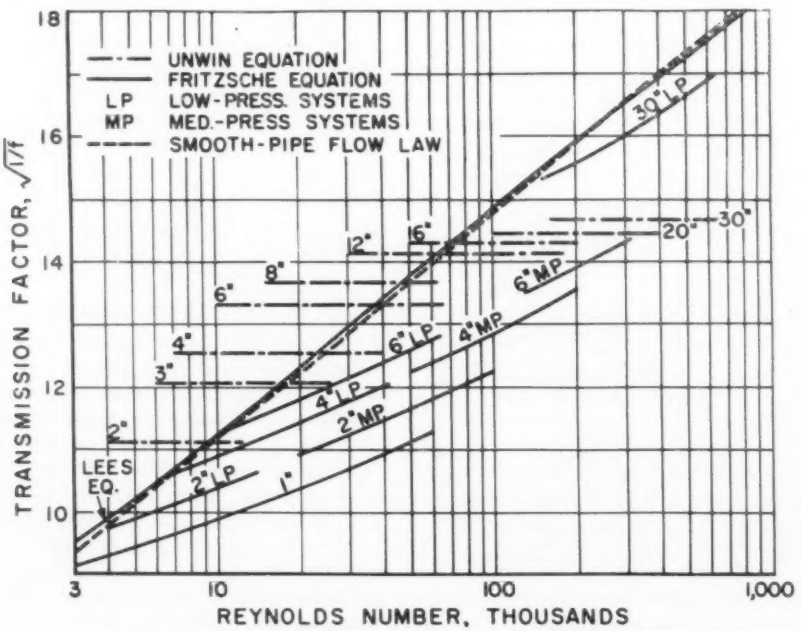

Fig. 10. Comparison of the Lees, Unwin and Fritzche equations with the smooth-pipe law for low- and medium-pressure systems.

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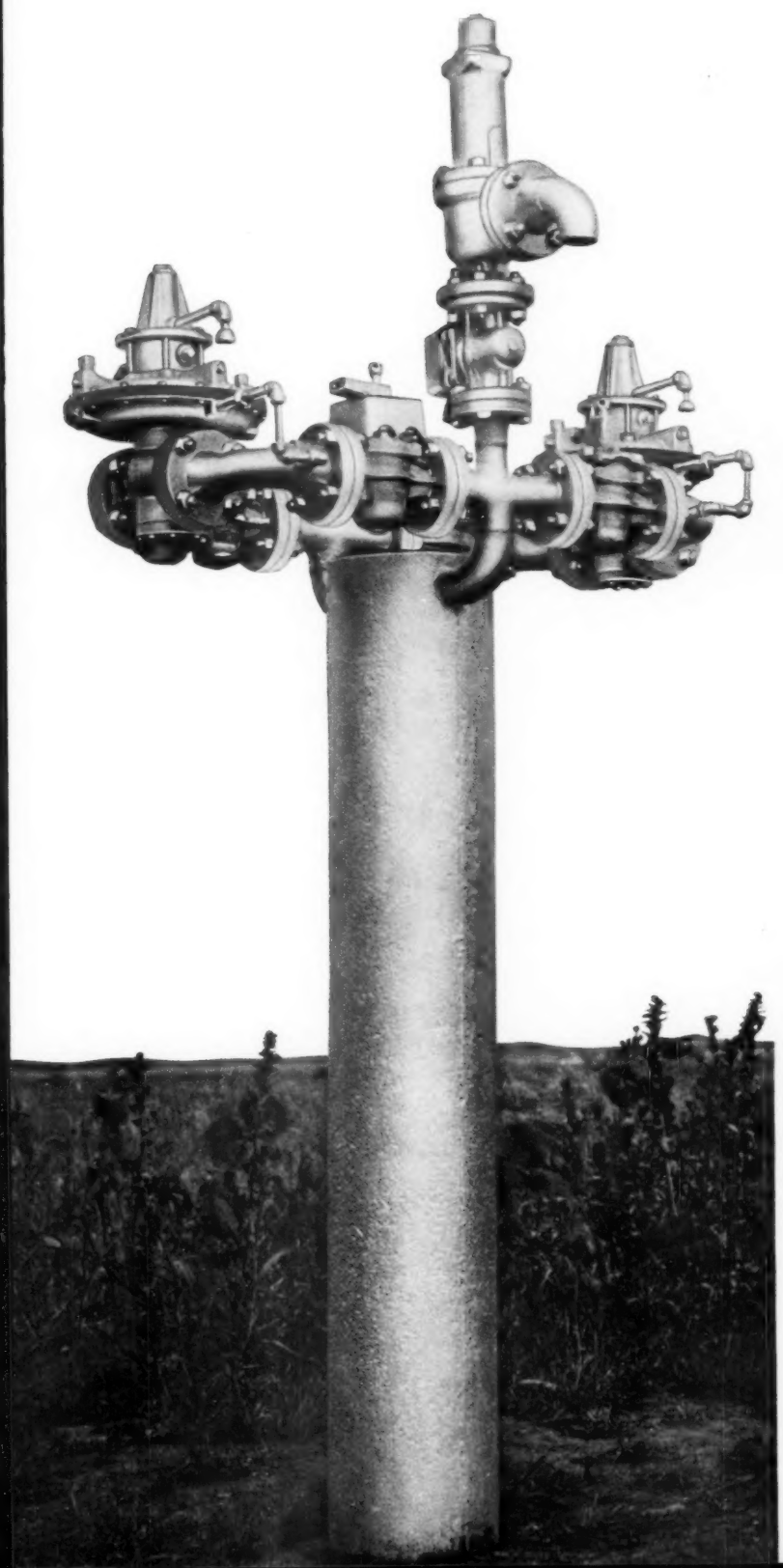

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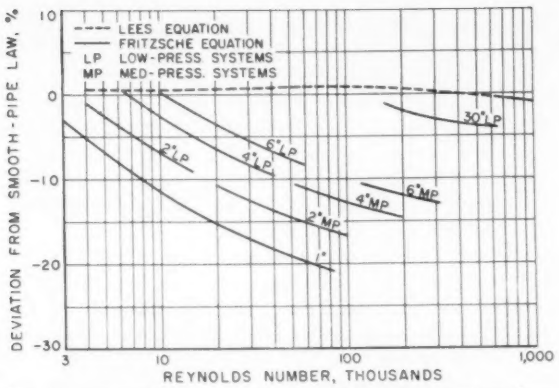

Fig. 11. Per cent deviation of Lees and Fritzche equations from the smooth-pipe law.

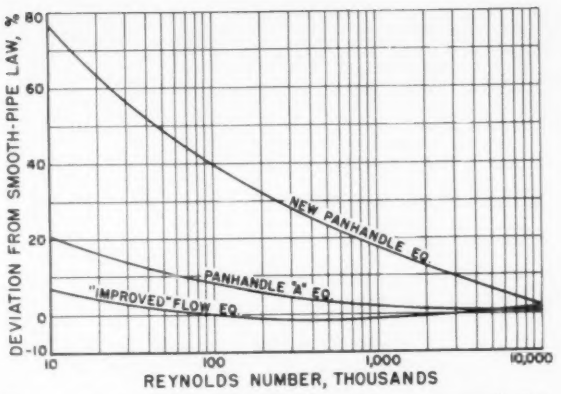

Fig. 13. Per cent deviations of Panhandle and "Improved" flow equations from the smooth-pipe law.

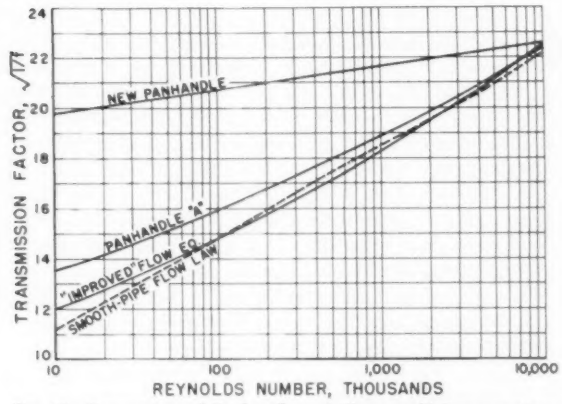

Fig. 12. Comparison of Panhandle and "Improved" flow equations with smooth-pipe law.

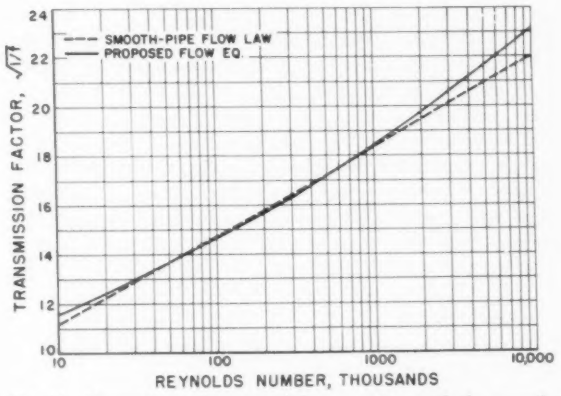

Fig. 14. Comparison of proposed flow equation with the smooth-pipe law.

ness of 2 mils, and 10 in. or larger in diameter. It represents much rougher pipe in the smaller diameters. The Panhandle "A" equation is shown to be a very good approximation to the fully-turbulent flow law for high-pressure distribution systems involving clean commercial pipe. However, the direct use of the fully-turbulent flow law does not present any significant complication over the use of the Waymouth or Panhandle "A" equations, and has the added advantage of permitting a physical interpretation of pipe resistance factors adjusted for abnormally dirty pipe.

Substitution of the fully-turbulent flow law into the general flow equation gives:

$$Q_b = C \frac{T_b}{P_b} \frac{(P_1^2 - P_2^2)\, D^5}{G\, T_{avg}\, Z_{avg}\, L} 4 \log \frac{3.7\, D}{k} \qquad (7)$$

or for distribution calculations where $Z_{avg} \cong 1$:

$$\Delta (P^2) = \left(\frac{P_b}{4\, T_b\, C}\right)^2 \frac{GT_{avg}\, L}{D^5} \left(\frac{1}{\log 3.7\, D/k}\right)^2 Q_b^2 = KQ_b^2 \qquad (8)$$

where:

$$K = \left(\frac{P_b}{4\, T_b\, C}\right)^2 \frac{GT_{avg}\, L}{D^5} \left(\frac{1}{\log 3.7\, D/k}\right)^2 \qquad (9)$$

If solution of a given distribution system network flow problem by use of the proposed flow equation indicates that fully-turbulent flow occurs to a significant extent, a second solution should be obtained by use of Equation 7, using a constant value of effective roughness for all pipe sections that is representative of clean pipe roughness, such as 0.7 mil for steel pipe. If the calculated pressures are still significantly higher than the measured pressures (and they probably will be), resistance factors in the system will have to be modified on a trial-and-error basis until reasonably close agreement is obtained between calculated and measured pressures. In making this adjustment of resistance factors, which will tax the design engineer's judgment and knowledge of the system to the fullest, attention should be focused on the primary trunk and feeder mains. The final adjusted resistance factors can then be translated into values of effective roughness. The establishment of the range of effective roughness encountered in different distribution systems with various past histories should be helpful in the estimation of resistance factors for dirty distribution system piping in general. In particular, such effective roughness values would provide a basis for quantitative comparison, between gas distribution systems, of the effect of dirt in the pipe.

If the distribution system design engineer has reason to believe that the dirt both decreases the

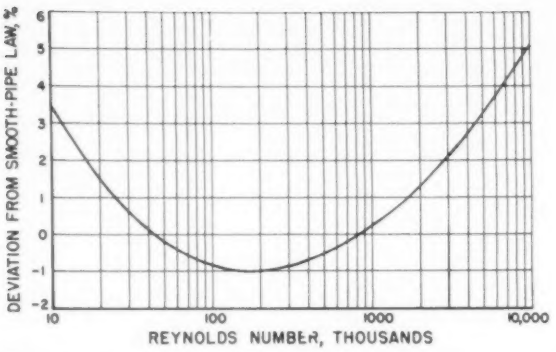

Fig. 15. Per cent deviation of proposed flow equation from smooth-pipe law.

cross-sectional area of the pipe and roughens the internal pipe wall, the order of magnitude of the two effects can be determined only by estimating the effective diameter of the pipe on the basis of inspection at cuts in the line made for repair or construction purposes.

The modification of flow formulas to describe the behavior of older distribution systems containing deposits of various types is, by its nature, a problem that will continue to require considerable exercise of engineering judgment based on experience with the particular system under study.

• Conclusions

On the basis of well-established fundamentals of fluid flow and available information on the roughness of commercial steel pipe and the range of flow rates encountered in various diameters of piping in gas distribution systems operated at the commonly used pressure levels, a comparison of the accuracy to be expected of 13 gas flow equations indicates:

(1) For low-pressure distribution systems comprised of pipe with effective roughnesses no greater than 5 to 10 times the effective wall roughness of clean, commercial steel pipe, moderately accurate results can be obtained by use of the Pole equation for pipe 4 in. or less in diameter and of the Unwin and Spitzglass equations for 12-in. and smaller pipe. Very accurate results can be obtained by use of the Blasius and Mueller equations for 8-in. and smaller pipe.

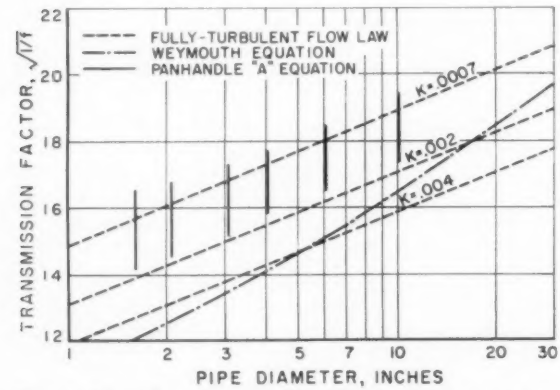

Fig. 16. Comparison of Weymouth and Panhandle "A" equations with fully-turbulent flow law.

(2) For intermediate- and medium-pressure distribution systems comprised of pipe with effective roughnesses no greater than that of rough commercial steel pipe, acceptable accuracy can be obtained by use of the Mueller and Blasius equations in 2-in. and smaller pipe, and by use of the Improved flow equation for 6-in. and larger pipe.

(3) For high-pressure distribution systems comprised of pipe with effective roughness equivalent to that of clean, commercial steel pipe, acceptable accuracy can be obtained only by use of the Improved flow equation for pipe 2-in. or more in diameter.

Therefore, none of these flow equations can be expected to give acceptable accuracy over the entire range of pipe diameters, operating pressure levels, and flow rates encountered in distribution system operations involving clean pipe, and a new flow equation has been proposed. The accuracy to be expected of this equation is ± 1 per cent for most distribution system flow calculations, and ± 2 per cent for all distribution system flow calculations except those involving 3-in. and smaller pipe in low-pressure systems.

A flow equation based on direct use of the fully-turbulent flow law is recommended for flow calculations involving unusually rough pipe. In addition, a rational approach is presented for the use of this equation, in conjunction with the proposed flow equation, to represent flow behavior in distribution systems containing dirty pipe.

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This article is a revision of an article under the same title presented by Messrs Wilson and Ellington before the AGA Distribution Conference, on May 5, 1958, at New York City.

KNOW THY ENEMIES

a FACTUAL study of the electric heat pump

By WILLIAM W. CLARK
Eastern Editor

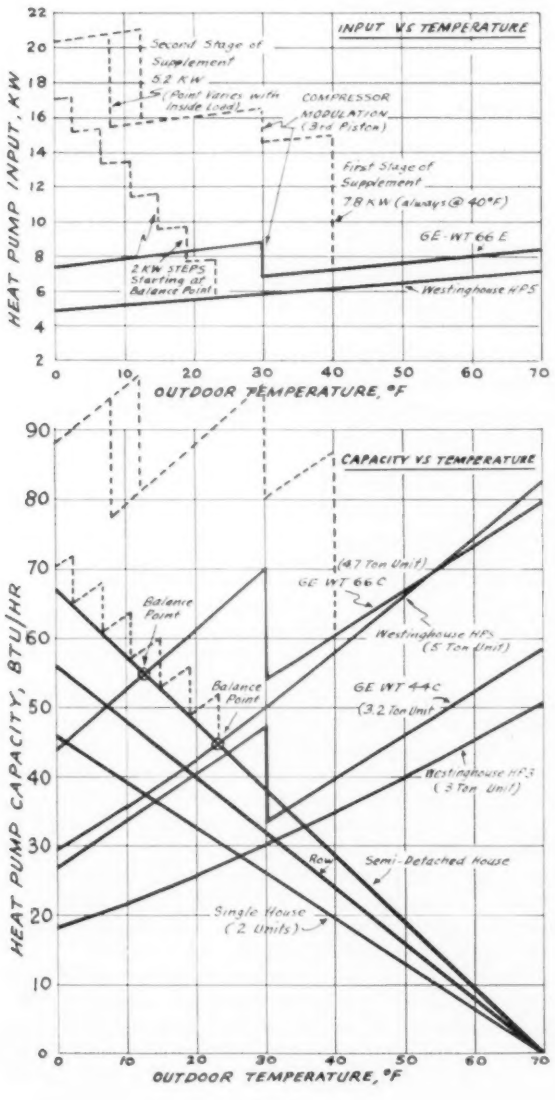


Fig. 1.

TODAY the heat pump is an established fact, and a rather well established factor in certain southern markets. True, it did run into some major difficulties in certain areas last winter, and offending units were jerked out in carload quantities and replaced with conventional jobs using gas to produce heat. But we would be deluding ourselves if we should take the attitude that these failures were fatal. Experience shows us that it's probably only a matter of time until the heat pump is pretty well de-bugged and ready to do a competent year-around air conditioning job.

When the time comes, the heat pump is sure to give us a good run for our money in the mild climates. Southern and southwestern utilities are well aware of this. But what sort of future does it face in the colder climates, where degree days each year are counted in the thousands?

A large northern utility has made some thorough and carefully detailed studies of the heat pump, including comparative economics, to determine the extent of the threat in the colder areas.

Generally, it has concluded that the coefficient of performance will need to be improved rather markedly if the heat pump is to compete—even if some fairly drastic electric rate-making tactics are used. However, the gap between the economics of the heat pump and other, more conventional types of air conditioning systems is being closed, and the threat is becoming a very real one.

Let us examine very carefully some of the findings in the studies so that we may judge the threat for ourselves.

First, what type of alternative systems are there in the market—or are there coming on the market—and how do they all stack up, one against the other and all against the heat pump?

On the gas side, the only one in the market is the Arkla-Servel. This is the conventional absorption system. Cooling and heating capacities of the two popular domestic models are 3.5 tons of cooling, 96,000 Btu output; 5 tons, 96,000 Btu or 144,000 Btu.

Arkla has some distinct advantages—reasonable compactness, silence, comparatively low maintenance; and it is a single unit with a single set of controls.

However, being water-cooled, it requires either substantial quantities of water or a cooling tower. The former adds on operating costs, the latter runs up first costs, adds on some operating costs, requires maintenance, and is unsightly. A successful air condensing system would wipe out these problems, so AGA research has tackled the problem.

The unit also requires a chimney.

Carrier is currently conducting field tests, and expects to be on the market with a gas-fired absorption unit by next year. This will be an add-on unit for remote outdoor installation; air cooled, of 3-ton capacity. It is expected that, when once in quantity production, the cost of the unit together with a 100,000-Btu input gas-fired warm air heating furnace will be competitive with the better quality electric units. Gas consumption may be somewhat higher than with the Arkla-Servel.

This unit has been hailed as the "first truly competitive gas-fired cooling unit" in first cost.

Meanwhile, as is well known, other manufacturers are working to develop other types of systems, and AGA research is moving rapidly on still other types. But at this writing, their market prices, operating costs, and ultimate coefficients of performance are mainly matters for conjecture.

The absorption system, then, for all practical purposes, is the only gas standard bearer, and it must be measured against these three conventional types:

1. Gas heating with electric compression cooling. This type is today the most widely used, and for the northern climes has the lowest operating costs as well as the lowest first costs of any types. It is available in nominal cooling capacities of 2, 3, and 5 tons. Heating units may be sized as desired, in a wide range.

These units are either water- or air-cooled. The same fans and filters are used for cooling as well as heating. A chimney is required.

2. Electric resistance heating and electric compression cooling. This system uses direct electric resistors imbedded either in glass panels or in the plaster of the ceiling or side walls of the area to be heated. It may also be used indirectly, with either air or water as a conducting medium. For cooling, conventional window units are used. This type of installation is competitive nowhere, except where giveaway electric rates prevail (in the TVA area, for example).

This system is fully automatic, with both the heating elements and the window cooling operating units from individual room thermostats. The heating cycle requires no chimneys and is completely noiseless, but with window units for cooling, there is a blockage of windows, and the appearance of the house suffers.

TABLE 1. Cost of complete installation for various combinations of heating and cooling systems for typical homes.

TYPE SYSTEM	TYPE HOME	SIZE OF COOLING UNIT (TONS)	PRICE TO DEALER OR UTILITY OF HEATING - COOLING UNIT - DELIVERED ONLY	TOTAL COST OF INSTALLATION INCL. EQUIPMENT, DUCTS, LABOR, OVERHEAD AND PROFIT
Servel Gas Air Conditioner (Water Cooled)	Typical Inside Row (2 story) with Recreation Room	3.5	$1,150.00	$1,930.00
Electric Compressor and Gas Furnace (Water Cooled)	Typical Inside Row (2 story) with Recreation Room	3.0	$1,025.00	$1,675.00
Electric Compressor and Gas Furnace (Air Cooled)	Typical Inside Row (2 story) with Recreation Room	2.75	$1,180.00*	$1,900.00
Heat Pump (Air to Air)	Typical Inside Row (2 story) with Recreation Room	3.2	$1,200.00	$2,500.00
Servel Gas Air Conditioner (Water Cooled)	Typical Semi-detached (twin rancher) with Recreation Room	3.5	$1,150.00	$1,930.00
Electric Compressor and Gas Furnace (Water Cooled)	Typical Semi-detached (twin rancher) with Recreation Room	3.0	$1,025.00	$1,750.00
Electric Compressor and Gas Furnace (Air Cooled)	Typical Semi-detached (twin rancher) with Recreation Room	3.5	$1,200.00	$2,000.00
Heat Pump (Air to Air)	Typical Semi-detached (twin rancher) with Recreation Room	4.7	$1,450.00	$3,000.00
Servel Gas Air Conditioner (Water Cooled)	Typical Single (2 story) with Recreation Room	5.0	$1,500.00	$2,330.00
Electric Compressor and Gas Furnace (Water Cooled)	Typical Single (2 story) with Recreation Room	5.0	$1,300.00	$2,150.00
Electric Compressor and Gas Furnace (Air Cooled)	Typical Single (2 story) with Recreation Room	4.5	$1,475.00	$2,350.00
Heat Pump (Air to Air)	Typical Single (2 story) with Recreation Room	6.4 (2-3.2 units)	$2,400.00 (2units)	$4,000.00

* A LOW PRICED 2.75 TON SEALED CIRCUIT AIR COOLED UNIT AND A 100,000 BTU INPUT FURNACE CAN BE PURCHASED BY A DEALER FOR $825

TABLE 2. Operating costs for heating and cooling a typical row home using various combinations of heating and cooling systems.

CALCULATED HEAT LOSS - 43,000 BTU's PER HOUR
CALCULATED HEAT GAIN- 35,000 BTU's PER HOUR

ROW HOME

Type System	Costs for Heating Gas $	Elec. $	Total $	Costs for Cooling Gas $	Electricity $	Water $	Total $	Total Operating Costs $	Rates Used Gas per therm	Elec. per KWH	Water per M gallons
Servel Gas Air Conditioner (Water Cooled)	105	6	111	50	6	36	92	203	12.5¢	1.8¢	17.2¢
Electric Compressor Cooling with Gas Furnace (Water Cooled)	105	6	111	--	43	28	71	182	12.5¢	1.8¢	17.2¢
	105	9	114	--	66	28	94	208	12.5¢	2.75¢	17.2¢
Electric Compressor Cooling with Gas Furnace (Air Cooled)	105	6	111	--	56	--	56	167	12.5¢	1.8¢	--
	105	9	114	--	86	--	86	200	12.5¢	2.75¢	--
Heat Pump (Air to Air)	--	145	145	--	71	--	--	216	--	1.8¢	--
	--	222	222	--	109	--	109	331	--	2.75¢	--

Furthermore, since heating costs are high, houses where such systems are installed are tightly constructed and heavily insulated, and air changes per hour fall below the optimum. The result is stuffiness and disagreeable odors.

3. And now, the heat pump. This is a 3- to 5-ton electrically operated compression cooling unit.

The heat pump is designed for either outside or inside installation. Installation costs are reduced by the elimination of chimneys, cooling towers, and fuel delivery lines.

Rate-wise, the heat pump's biggest drawback has been the necessity of using supplementary electric resistance heaters to provide the required capacity boost during severe winter weather—that is, when the heat loss of the house exceeds the output of the pump. The general practice has been to size the unit to provide adequate cooling, adding "strip" heaters to make up the required additional heating capacity. In many areas where the cooling load exceeds the heating load, strip heaters are not needed, so the heat pump makes an attractive air conditioner from the standpoint of operating costs. (First costs are something else again, as we shall see presently.)

On the other hand, in areas where the heating load exceeds the cooling load, the picture changes. Since the operating efficiency of the heat pump decreases as the outside temperature decreases, more and more strip heaters must be added as the weather grows colder. The breaking point where the required use of strip heaters becomes excessive, and therefore uneconomic, occurs (at present) where the annual aver-

TABLE 3. Operating costs for heating and cooling a typical semi-detached home (twin-rancher) using various combinations of heating and cooling systems.

CALCULATED HEAT LOSS - 58,900 BTU's PER HOUR
CALCULATED HEAT GAIN - 41,650 BTU's PER HOUR

SEMI-DETACHED HOME

Type System	Costs for Heating Gas $	Elec. $	Total $	Costs for Cooling Gas $	Electricity $	Water $	Total $	Total Operating Costs $	Rates Used Gas per Therm	Elec. per KWH	Water per M gallons
Servel Gas Air Conditioner (Water Cooled)	143	8	151	60	6	45	111	262	12.5¢	1.8¢	17.2¢
Electric Compressor Cooling with Gas Furnace (Water Cooled)	143	8	151	--	55	35	90	241	12.5¢	1.8¢	17.2¢
	143	12	155	--	84	35	119	274	12.5¢	2.75¢	17.2¢
Electric Compressor Cooling with Gas Furnace (Air Cooled)	143	8	151	--	63	--	63	214	12.5¢	1.8¢	--
	143	12	154	--	96	--	96	250	12.5¢	2.75¢	
Heat Pump (Air to Air)	--	207	207	--	79	--	79	286	--	1.8¢	--
	--	316	316	--	120	--	120	436	--	2.75¢	--

age temperature is below about 50 degrees.

Another drawback of the heat pump encountered in colder zones is the tendency of the heat absorption coils to frost up when outside temperatures drop to freezing. Some of the instrument's heat output must be diverted to cure this condition, impairing the pump's effectiveness.

If a manufacturer could solve the sizing problem on the heating cycle so as to eliminate the strip heaters, or at least materially lower the temperature point at which they must be pressed into use, the attractiveness of the heat pump would be greatly enhanced. General Electric, a prime manufacturer of the pumps, has tried this. More heating capacity has been built into some GE units through the incorporation of an extra cylinder and piston for use during the winter season. This third piston is not loaded until the outside temperature drops to 30°F, at which point an removal of 12,000 Btu per hour of latent and sensible heat.

Type System	*Nominal Rating*	*Actual Rating*	*Heat Absorbing Capacity Btu/Hour*	*Type Condenser*
Servel Gas Unit	3 T	3.5 T	42,000	water
Servel Gas Unit	5 T	5.0 T	60,000	water
Electric Compression	3 T	3.0 T	36,000	water
Electric Compression	5 T	5.0 T	60,000	water
Electric Compression	3 T	2.7 T	32,000	air
Electric Compression	5 T	4.6 T	54,700	air
Electric Compression	3.5 hp	3.0 T	36,000	air
Electric Compression	5.8 hp	5.0 T	60,000	air
Heat Pump	3.0 T	2.5 T	30,000	air
Heat Pump	5.0 T	4.2 T	50,000	air

It will be noted that there is a considerable loss of cooling capacity in the compression units when air cooling is substituted for water cooling.

TABLE 4. Operating costs for heating and cooling a typical single home (two-story) using various combinations of heating and cooling systems.

CALCULATED HEAT LOSS - 97,000 BTU's PER HOUR
CALCULATED HEAT GAIN - 56,000 BTU's PER HOUR

SINGLE HOME

Type System	Costs for Heating			Costs for Cooling				Total Operating Costs	Rates Used		
	Gas	Elec.	Total	Gas	Electricity	Water	Total		Gas per Therm	Elec. per KWH	Water per M gallons
	$	$	$	$	$	$	$	$			
Servel Gas Air Conditioner (Water Cooled)	236	13	249	72	8	51	131	380	12.5¢	1.8¢	17.2¢
Electric Compressor Cooling with Gas Furnace	236	13	249	--	62	43	105	354	12.5¢	1.8¢	17.2¢
(Water Cooled)	236	20	256	--	94	43	137	393	12.5¢	2.75¢	17.2¢
Electric Compressor Cooling with Gas Furnace	236	13	249	--	82	--	82	331	12.5¢	1.8¢	--
(Air Cooled)	236	20	256	--	125	--	125	381	12.5¢	2.75¢	--
Heat Pump (Air to Air)	--	335	335	--	113	--	113	448	--	1.8¢	--
	--	511	511	--	173	--	173	684	--	2.75¢	--

outside thermostat actuates a simple solenoid valve, allowing refrigerant to pass into the previously idle chamber. This gives an initial boost in heating capacity of about 13,000 Btu per hour on the 3.2-ton unit, about 16,000 Btu per hour on the 4.7-ton unit (see *Fig. 1*).

While this helps on the heating cycle, the extra piston is simply a drag on the cooling cycle, sharply reducing efficiency. So to date it has proved to be a mixed blessing.

In any comparison of systems, it must be remembered that ratings are nominal, and there is always a variance between nameplate ratings and actual capacities.

Below are listed ASRE ratings on various types of systems, based on outside air temperature 95 degree dry bulb at 50 per cent relative humidity; inside air return to unit, 80 degree dry bulb at 50 per cent relative humidity, and cooling water temperature of 75 degree. One ton of refrigeration is equal to the removal of 12,000 Btu per hour of latent and sensible heat.

Efficiencies of the various types of electric air conditioning are very high. Whereas the Servel (water cooled) has a heating efficiency of 80 per cent and a cooling efficiency of 55 per cent, the other three systems have efficiencies as follows: Electric compressor cooling (water cooled) with gas furnace, 80 per cent on heating, 290 per cent on cooling; heat pump (air cooled), 185 per cent on heating, 265 per cent on cooling; strip heater and window cooling units (air cooled), 100 per cent on heating, 195 per cent on cooling.

Now let's see how competitive these various types of air conditioners are. The utility made intensive surveys to determine the probable installation costs for three types of dwellings that are common in the area. First is a "row house," which is a line of houses of uniform architecture, connected by party walls. One of the attractive features of these units is their low heating cost. Second is a "semi-detached" home, also known as a "twin." This is two identical houses hooked

together with the party wall. These are "ranchers," meaning they are single story, plus basement (recreation room). Third is the single, or conventional two-story home.

The cost findings are shown in *Table 1.*

In the costs quoted, $120 has been included for a chimney where gas heating is used. With heat pumps, it has been assumed that an electric hot water heater would be used, so no chimney would be required.

Water towers were not included in the cost data. It was felt that with small domestic units, water consumption with city water mains being used for 100 per cent makeup would cost so little that the water tower would not be economical, weighing first cost, possible structural changes required, and upkeep. Actual water costs in this city run about 17 cents per thousand gallons. Consumption would average about as follows, based on a 600-hour summer cooling season:

Type Unit	*Water Consumption Per Hour (Average)*	*Water Cost Per Season*
3-ton compression unit	270 gal.	$28
Servel 3-ton unit	350 gal.	$37
5-ton electric compression unit	450 gal.	$47
5-ton Servel unit	580 gal.	$60

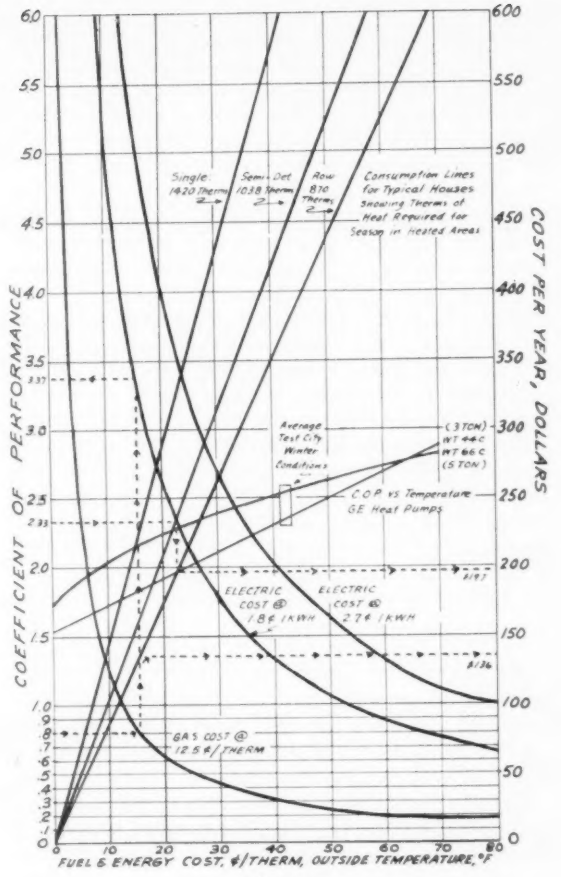
Using the installation cost figures which were developed, it can be seen that in first costs, the combination gas and electric units still have a distinct edge. For row-house installation, the Servel units are in the premium price class, but in single home installation the price spread, percentagewise, tends to narrow. The heat pump, however, is at present out of the ball park in every category.

This may not always be true, however. If the electric industry wants the heating load badly enough in some areas—and it appears it does—sales may be subsidized on a rather wide scale and other promotional pricing tactics may be used. Further product development and mass production will have their effects, too. So if we assume that the present price relationships will not hold, the comparative operating costs of the various systems become of first importance.

Ratemaking is, of course, the base from which operating costs spring. The level at which these will be set in the future is determined not only by simple economics but also by the attitude of the electric utilities. How important to them is the electric heating load? What are the economic facts of life, rate-wise?

Electric utility rate engineers agree that the rising summer cooling peaks make corresponding electric winter heating very attractive—almost, in many cases, a must. They recognize that the first cost must be brought down and that reliability of operation must be improved measurably. Given these two conditions, two requisites still exist: the coefficient of performance must be increased—to a minimum level of about 3, according to some experts—and a realistic rate must be imposed.

Today, the coefficient of performance does not measure up. As we have seen, for strip heaters it is 1.0. GE's WT66C heat pump, for no-load conditions, with no electric resistance heating, is 2.8. A combination


COEFFICIENT OF PERFORMANCE
COST PER YEAR, DOLLARS
FUEL & ENERGY COST, ¢/THERM, OUTSIDE TEMPERATURE, °F
Single 1420 Therms
Semi-Det 1038 Therms
Row 810 Therms
Consumption Lines for Typical Houses Showing Therms of Heat Required for Season in Heated Areas
Average Test City Winter Conditions
(3 TON) WT 44C WT 66C (5 TON)
C.O.P. vs Temperature GE Heat Pumps
ELECTRIC COST @ 1.8¢ / KWH
ELECTRIC COST @ 2.7¢ / KWH
GAS COST @ 12.5 ¢/THERM
Fig. 2

of the two units in a relationship that would exist under climate conditions similar to those in our "test city" would range from 2.0 to 2.7.

The way in which the two heating systems are combined to do the heating job is shown in *Fig. 1.* The input-vs.-temperature curves were developed for the (nominal) 5-ton units of Westinghouse and GE. For capacity-vs.-temperature, both GE and Westinghouse 3- and 5-ton units are shown. Both GE models incorporate the third piston feature, which comes in at 30°.

The dotted lines on the chart show the magnitude and outside temperature conditions for the necessary resistance heaters.

The Westinghouse unit adds resistance heating in 2-kw steps, at a point where the heating capacity of the heat pump is exactly equal to the heat loss of the structure. In the case of the GE unit, the first stage of electrical resistance heating at 7.8 kw is introduced at 40 degrees F outside temperature. Additional resistance heating, if needed, is added when the outside temperature drops sufficiently to cause the heating capacity of the unit with the resistance heaters to be approximately equal to the heat loss of the structure. The high demand of the resistance heaters, added to the demand of the unit, makes the heat pump undesirable from a load standpoint, unless a demand

feature is contained in the electric rates.

How high should the demand rate be? This of course would depend on a great many factors. However, it is generally agreed that in an area such as our "test city," with its fairly severe winters, the differential between the present summer air conditioning rate and the heat pump rate would have to be a sizable one.

In comparing the operating costs of the systems, we have assumed three different rates: gas at 12.5 cents per therm, electricity at an air conditioning rate of 1.8 cents, and again at the demand rate of 2.75 cents. Reference to *Tables 2, 3,* and *4,* which assume a coefficient of performance of 2.5, shows that the costs of operating the heat pump at the demand rate would be double the costs of gas for heating. Even at the unrealistic 1.8-cent rate, the heat pump would still be more expensive to operate than would the Servel.

The cost and efficiency relationships are also shown graphically in *Fig. 2.* The dotted lines show typical cases of gas heating at an efficiency of 80 per cent, costing $136 to heat a row house requiring 870 therms of energy, and a GE heat pump with a COP of 2.33 and an electric rate of 1.8 cents per kwh, costing $197. The extension of the dotted lines from the intersection of the 80 per cent line with the gas cost line at 12.5 cents per therm, shows that the COP of a heat pump would have to be 3.37 in order for it to be competitive with gas.

Under these operating conditions, electricity would need to be priced at about 1.2 cents to be equal in cost to 12.5-cent-per-therm gas.

These figures, of course, are only applicable to one area. Higher gas rates coupled with lower electric rates, plus a lower demand, could swing the operating cost in favor of the heat pump. On the other hand, where the demand is lower, gas rates are also usually lower. Each area, then, presents its own particular set of conditions which must be taken into account in appraising the heat pump threat.

In any event, no one can deny that the heat pump is here to stay. Even the most conservative gas utility men are sensing the urgency of improving present gas air conditioners and bringing those now in the research stages into full production. The strong support they have given Arkla-Servel is indicative of this. As one utility executive has said, "We *must* become active in the air conditioning field." Nineteen fifty-eight looks like the year to start. ■

United Gas air conditions its meter shop

EMPLOYEES will be more comfortable—therefore more efficient—and more effective temperature and humidity control will result from the installation of a gas-fired air conditioning system at United Gas Corp.'s Houston meter shop.

A 36-ton Ready Power remote unit, using a gas-driven internal combustion engine to operate the compressor, is the core of the air conditioning system. Located just outside the meter shop, it is housed in a small structure with corrugated asbestos walls, matching the adjacent water tower.

Inside the shop, floor space was conserved by suspending the air-handling units from the ceiling. For economy, ducts are suspended from the ceiling in the cooled area, thus requiring no insulation. The shop itself is insulated with 4 in. of glass wool over a ceiling of acoustical paneling.

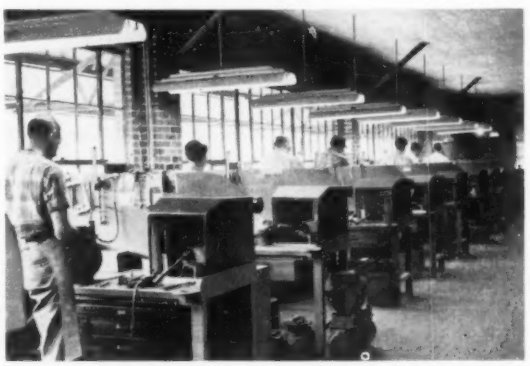
To reduce the capacity of air conditioning required, a ventilating system was installed to exhaust the heat and obnoxious odors from the 11 soldering furnaces.

"Before the shop was air conditioned," W. P. LeBlanc, supervisor in charge of the meter shop, said, "it was ventilated by several large exhaust fans. While they provided some measure of comfort by moving the air, they did not actually cool the shop. As a result, the temperature during warm summer afternoons often reached the 90's. The installation of the air conditioning equipment now provides a uniform temperature of 75 degrees around the clock."

In proving meters after they have been renovated or repaired, the temperature of the meter bodies must be the same as that in the proving room.

"Now that the meter shop and the adjoining proving room are uniformly air conditioned, we have eliminated long waiting periods while the temperature of the meter bodies reached room temperature," Mr. LeBlanc explained.

Because all the air is filtered, housekeeping has been reduced, and the odors characteristic of an industrial neighborhood have been eliminated.



Hoods for soldering furnaces, located on right side of each work bench, are connected to ventilating system which removes heat and obnoxious odors.

What the serviceman should know about . . .

OVEN CONTROLS

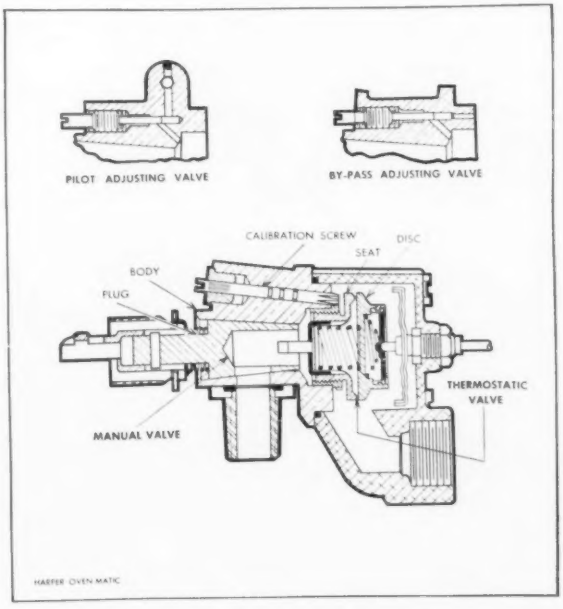
By PAUL CAMPBELL, Product Engineer
Harper-Wyman Co., Chicago

THE oven thermostat in use today is basically four valves in one. Looking at a cross section of this control we find that it starts with a basic manual valve, usually of the plug and body type, which merely serves as a shutoff valve; the thermostatic valve, consisting of a seat and disc, which is controlled statically by a heat sensitive element, usually of a hydraulic type; and two small adjusting manual type valves that control the flow of gas to the standby pilot and to the main burner bypass when the thermostatic valve is closed. The control is operated by turning the dial to the desired temperature. This in turn opens the main shutoff valve and varies the space relationship between the seat and disc of the thermostatic valve. The small valves controlling the gas to the standby pilot and burner bypass are downstream of the main shutoff valve and must be adjusted to the gas on which they are to be used.

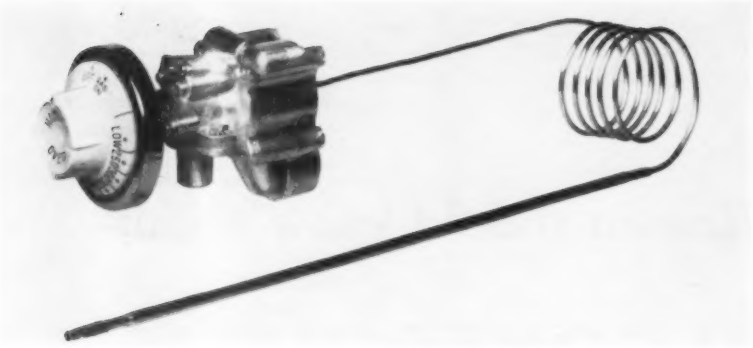
The temperature sensing element that controls the thermostatic valve is a sealed hydraulic unit filled with a heat stable liquid. The unit consists of a bulb, positioned in the oven so that it can sense the temperature of the air in the oven, a small capillary tube extending from the bulb to the thermostatic valve diaphragm or bellows that expands or contracts as the fluid in the bulb heats or cools with the temperature changes in the oven. The positioning of this bulb in the oven is of paramount importance and is inherent in the design of the oven so that if once positioned by the range manufacturer no further positioning in the field should be required.

Basically, then, a serviceman may be called upon to adjust the burner bypass valve, the standby pilot valve and/or to calibrate the thermostatic valve in such a manner that the oven will remain at the temperature indicated on the dial within specific limits.

The standby pilot valve should be adjusted so that the pilot has a flame approximately $^{3}/_{4}$ to 1 in. long when the control is on. In order to adjust the bypass valve the oven is brought up to a temperature of approximately 400 degrees by setting the dial at 400 degrees and leaving it there until the flame reduces in size. At this point the dial should be reset to 250 degrees and the bypass valve adjusted until a small bead of flame remains on the oven burner. The burner flame should be of such size that it will relight from



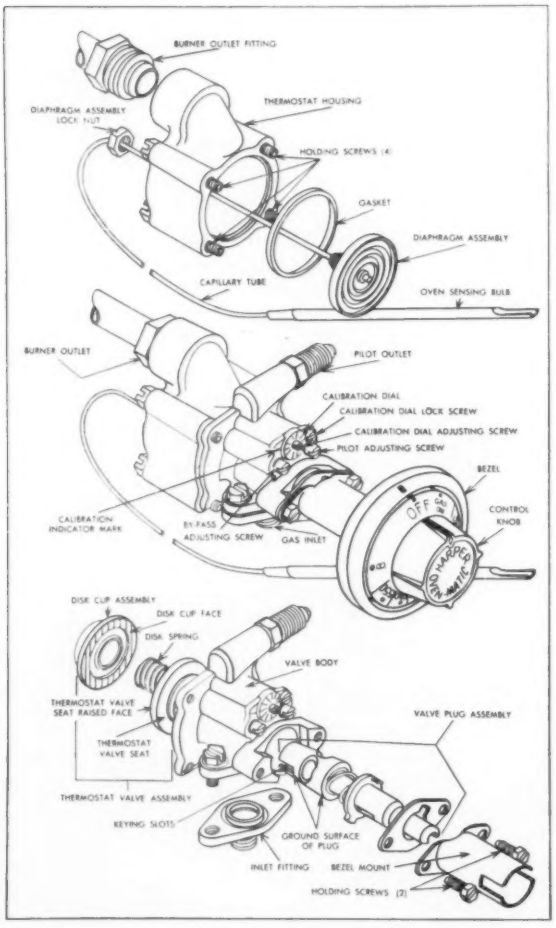
Cross section of an oven thermostat.



Harper-Wyman's Oven-Matic control.

the pilot in case it is for any reason extinguished while the control is on.

To adjust the thermostatic valve for correct temperature control of the oven, the manufacturer's recommendation should be followed. This calibration is accomplished by varying the relative locations of the seat and disc of the thermostatic valve by varying one or the other in relationship to the temperature-sensing unit that controls the thermostatic valve.



Exploded view of oven control.

This is accomplished by different means on the various thermostats and the thermostat manufacturer should cover this in his literature. Typical instructions by a thermostat manufacturer would be as follows in regard to temperature calibration.

Turn thermostatic knob to a 400-degree setting and light oven. Allow oven temperature to reach an equilibrium temperature which will require approximately 15 minutes. This equilibrium condition can be ascertained by taking temperature readings after 15 minutes and at 5-minute intervals thereafter using an accurate temperature indicating instrument. If the temperature of the oven does not vary more than 5 degrees plus or minus for three consecutive readings it can be assumed that equilibrium has been reached. If the equilibrium temperature then is within plus or minus 10 degrees of the 400-degree dial setting, the thermostat should be considered correctly calibrated and no further adjustments are required. If, however, the readings vary more than plus or minus 10 degrees the valve should be adjusted according to the manufacturer's instructions to compensate for this difference in temperature and the same procedure followed to allow a new equilibrium temperature to be arrived at and again compared to the 400-degree dial setting. This should be done until the desired results are obtained.

In addition to calibration, servicing of the valve may require one or more of the following—cleaning and regreasing of the manual shutoff valve portion, the cleaning of the thermostatic valve disc and seat surfaces, and/or replacement of the temperature sensing unit. If there is a malfunction of the temperature sensing unit, the unit can be replaced in the field or returned to the manufacturer for replacement.

Malfunction of the temperature sensing unit would be indicated by the inability to obtain the original calibration required or by a radical change in calibration after the control is once calibrated.

In recent years a thermal electric type safety shutoff valve has been used in conjunction with the oven thermostat with a constant burning pilot thermocouple arrangement to provide automatic ignition of the oven burner. In this type of arrangement the standby pilot valve on the thermostat is not used but rather the automatic pilot is controlled by a valve either incorporated in the safety shutoff valve or mounted in the manifold. ■

GAS · DISTRIBUTION NEWS

Florida's largest gas utility organized

Florida's largest gas utility was created when Peoples Water & Gas Co. of North Miami and the Tampa Gas Co. merged into Peoples Gas System Inc.

The new company, headed by President Phillip C. Crowen, has assets of $24.9 million. At present it operates manufactured gas distribution properties in Dade, Broward, and Hillsborough counties, serving more than 100,000 customers. It will convert to natural gas when Houston Corp.'s Texas-to Florida pipeline is completed next year.

Before the merger, Mr. Crowen said, the North Miami and Tampa companies were affiliates of Peoples Gas System. Two bottled gas companies, Peoples Gas Co. and Tampa Bottled Gas Co. (previously owned by the affiliated companies), will continue as wholly owned subsidiaries of Peoples Gas System.

Calling the merger the final step in preparing the company for natural gas, Mr. Crowen said the merger "will streamline our operations and simplify the financing of some $15 million of new funds which we plan to spend to convert our system to natural gas and expand it to make this new fuel available to more people in Florida."

Consumers adds 30,000 heating customers

Consumers Power Co., Jackson, Mich., has state PSC okay to connect 30,000 space heating customers, leaving some 140,000 still on the waiting list.

While Consumers has plans for getting additional gas supplies, the new customers will be supplied from reserves in Michigan fields and in storage.

PSC Commissioner Otis Smith said the PSC had reached no decision on a separate but related question of whether it should withdraw entirely from the field of setting restrictions on gas heating.

The commission first entered regulation of service to new applicants for space heating gas during the shortage following World War II. It has since withdrawn restrictions on all distributing gas utilities except Consumers, which urged a retention.

Consumers has negotiated with Trunkline Gas Co. and Panhandle Eastern Pipe Line Co. for additional gas supplies. Trunkline is seeking FPC approval of additional facilities. Upon such approval, Trunkline would deliver 100 MMcf per day to Consumers, beginning Oct. 1, 1959. Annual increases would boost this to a maximum of 200 MMcf per day in October 1963. Panhandle's plan is contingent upon the FPC allowing Panhandle to discontinue deliveries to Michigan Consolidated Gas Co.

Depot and repair shop planned by SoCal

A new facilities plant is being built in Pico Rivera by Southern California Gas Co., Los Angeles.

The new returned-material depot and meter repair shop will be used for the repair and maintenance of SoCal's precision equipment. Exclusive of site, the project will cost about $650,000.

Ohio Fuel starts $600,000 replacement job

Ohio Fuel Gas Co. is starting work on a $600,000 replacement job in northeastern Ohio. Eight Ohio counties will benefit from the work.

Fifteen miles of 12-$\frac{3}{4}$-in. line will replace sections of three existing lines that move gas from Holmes compressor station to OFG's network serving customers in Wayne, Stark, Carroll, Columbiana, Mahoning, Tuscarawas, Harrison, and Jefferson counties.

The new sections — replacing smaller pipe—will make it possible for Ohio Fuel to deliver more gas from the Holmes underground storage area.

International introduces complete new tractor line

International Harvester Co. used its experimental farm near Hinsdale Ill., to introduce the press to its complete new line of commercial and farm wheel tractors.

The 12 new tractors—in six power sizes—were housed under more than 81,000 sq ft of canvas. A series of shows—seven two-day and three one-day—was used to introduce the equipment to dealers.

Among equipment introduced was the new low-profile series International 240, 340, and 460 Utility tractors. These have 38, 45, and 61 estimated engine horsepower, respectively. Adapted to both industrial and farm applications, the new tractors are classed in size with the Farmall 240, 340, and 460.

Montana Power, Great Falls take quarrel to PSC

Montana Power Co., Butte, which supplies gas to Great Falls Gas Co., has asked the Montana PSC to terminate the contract between the two companies. Grounds: rates are discriminatory, unjust and unreasonable to Montana Power.

This International 460 Utility tractor, shown here with International-Wagner front-end loader and Danuser rear blade, is one of 12 new International and Farmall tractors just introduced.

The application asks for an increase in the wholesale price of gas and certain changes in conditions of service. Montana Power alleges it has been unable to negotiate a new contract with Great Falls. In turn, Great Falls has filed an objection on the grounds that the commission is without authority to modify the contract, such change being only by mutual consent of the parties to the contract.

Flow meter text makes eighth appearance

The eighth edition of "Principles and Practice of Flow Meter Engineering" by L. K. Spink is available from the Foxboro Co. for $15 per copy. The new edition features the latest developments in flow measurement, making the new text the largest, most complete and authoritative book on flow meter engineering.

The 549-page, hard-bound edition covers a much broader scope than earlier editions. However, it is conveniently arranged and indexed as a handbook for every-day one-source reference in commercial flow measurement.

Such subjects as the history of developments in flow metering, the theory of flow meters, and the use and installation of primary devices, meter mechanisms, and liquid, steam and gas flow measuring practices are covered.

Representing more than 30 years of cumulative research and experience, the latest text uses current AGA and ASME terminology, with all tables, curves, factors, etc., based on AGA Report No. 3.

The author, L. K. Spink, spent a lifetime specializing on flow measurement. From his early work with the AGA on orifice coefficients to his duties as a member of the committee which prepared AGA Report No. 3, he was a recognized authority on all phases of flow technology.

"Principles and Practice of Flow Meter Engineering" is priced at $15 per copy. The up-to-date practical flow measurement authority for industrial and academic work may be ordered from the Foxboro Co., Foxboro, Mass.

Automatic ignition effective Jan. 1, 1959

On Jan. 1, 1959, automatic ignition of all burners, including ovens and broilers, becomes mandatory on AGA approved gas ranges, thus practically eliminating the need for matches in the home insofar as gas is concerned.

In addition to safeguarding against human frailty, the improvement in modernity and convenience of the range will serve to strengthen the gas industry's competitive position.

The AGA is informing interested federal agencies, particularly those in housing, and the New York and Massachusetts housing agencies. In addition, the association is urging gas companies to inform large municipalities having building codes or ordinances limiting the sale or installation of gas appliances to those approved by the AGA or other recognized national authorities.

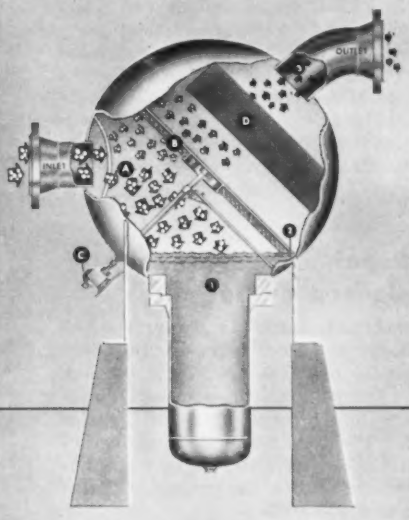
The mandatory provision has been held in abeyance until automatic ignition systems reached their present advanced state of reliability and efficiency.

Continued on page 74

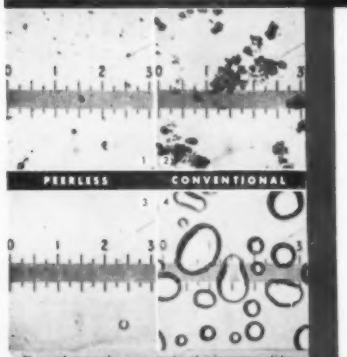
MORE EFFICIENT RESULTS!

PEERLESS SCRUBOSPHERE*

*Spherical scrubber for dust and liquid removal from gas flow



LEGEND OF ABOVE CUTAWAY
The majority of incoming liquid (A) and solid particles are directed to either side and down into reservoir (1). Lighter solid particles carried by gas stream are separated on surfaces of contactor (B) which are kept wet and clean by revolving thru liquid reservoir (2). Contactor is revolved by explosion-proof gear motor (C). Mist Extractor (D) removes any remaining liquid particles from gas stream prior to outlet (3).



These photographs were made of microscope slides introduced downstream of the Scrubosphere and a conventional vertical oil bath cleaner under the same operating conditions. Plates 1 and 2 show the comparative amounts of iron oxide not removed with the amounts introduced being identical. Plates 3 and 4 indicate comparative oil loss with vapor rate through the vessels being the same.

◆ LOOK AT THIS TEST The test at the left indicates the superiority of Peerless Scrubosphere over conventional oil bath dust scrubbers. The SCRUBOSPHERE operates with no loss of efficiency at low flows, minimum liquid loss, and very low pressure drop. Other outstanding features include easy vessel access with removable self-cleaning contactor, a sump for slugs of solid or liquid particles, and minimum cost.

For detailed information write for Bulletin No. 181

PEERLESS MANUFACTURING CO.
P.O. Box 13165 Dallas, Texas
Representatives in All Principal Cities

PEERLESS MFG. CO. DALLAS TEXAS

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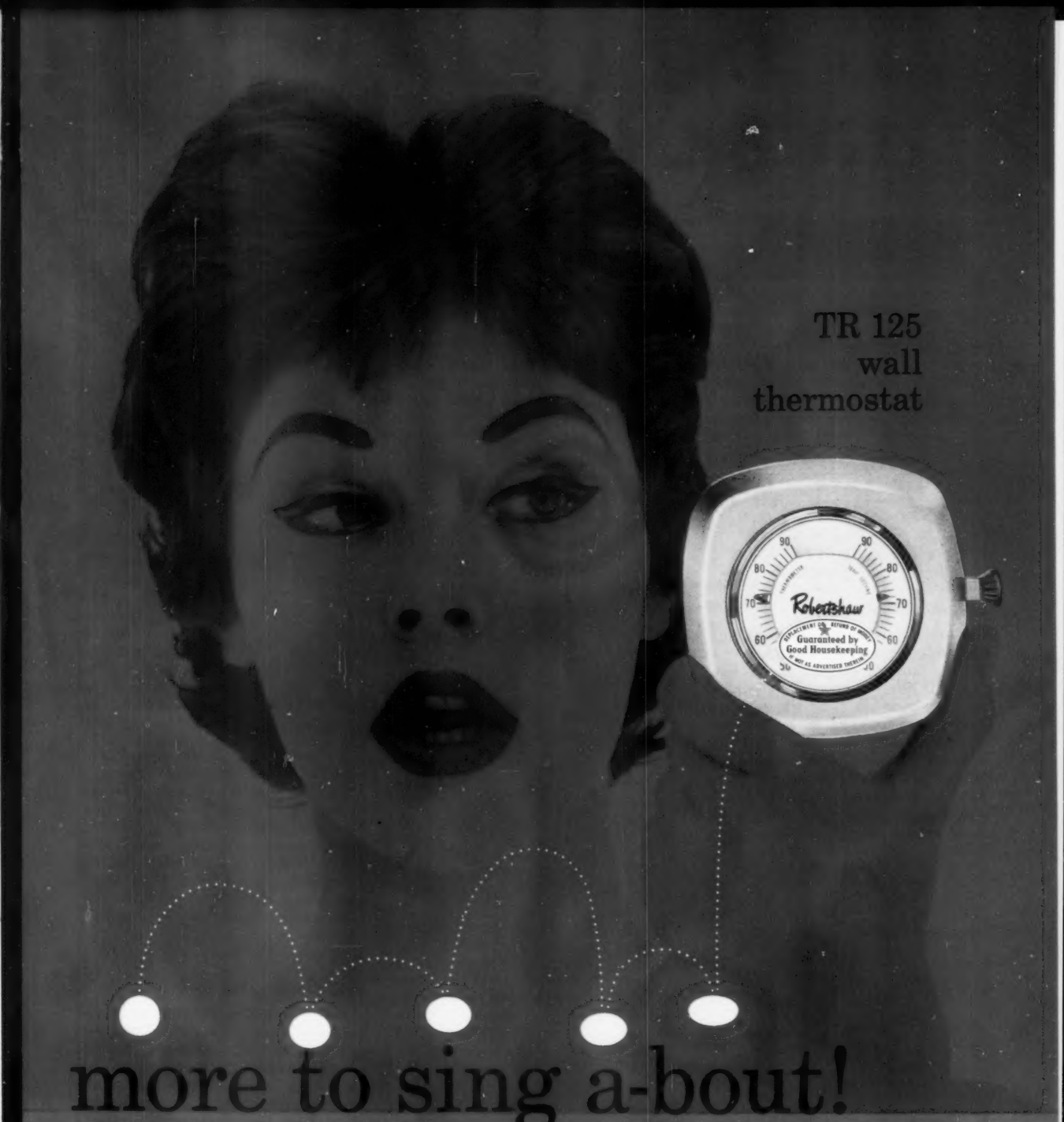

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feature controls designed, engineered
and backed by the name she knows best.....

ROBERTSHAW

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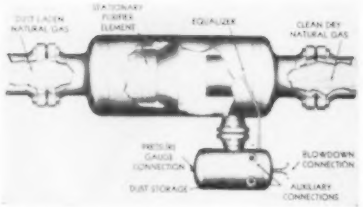
GAS DIGEST

New Products and Trade Literature

For more data on any of these items use the Readers' Service Card on pages 71, 72



1. Dust scrubber

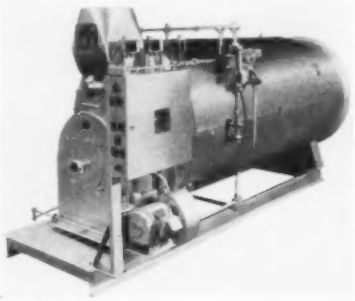
Maintenance-free dust scrubbing of gas in transmission and distribution lines is claimed by a new type LD Hi-eF scrubber. V. D. Anderson's new unit, which removes dust particles down to 10 microns in size, eliminates use of filters or screens to accomplish separation. While suitable for pressures up to 1000 psig, special units are available for pressures up to 15,000 psig.
V. D. Anderson Co.

2. "Texas Steer"

One tough part of pipeline construction is being made easier by Maloney's "Texas Steer." Pushing the "drag section" through the casing on highway crossings has long been a time-consuming, expensive job. According to Maloney, the Texas Steer, basically a funnel with a hinge along the back, eliminates the delay and expense of hanging up insulators or breaking them during the drag.
F. H. Maloney Co.

3. Taper face flange

New ratings broaden the service range of Tube Turns' lightweght, forged steel, taper-face welding neck flanges. On the basis of extensive fatigue and bending tests under simultaneous pressure, the flange is now recommended for 175 psi gas, liquid, or air service at 150 degrees. Their use is extended to heating, air conditioning and general service piping installations.
Tube Turns Division

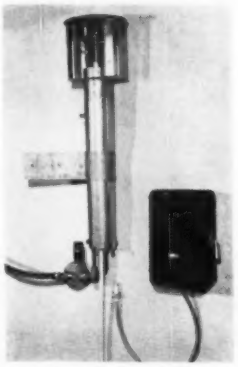


4. Boilers

A new line of WP (Whispering power) boilers is rated at 80, 100, and 125 hp by Eclipse Fuel Engineering. Although featuring quiet operation and competitive prices, the units are not stripped-down units. The line is normally equipped for gas firing but can be provided with full combination gas/oil burner and with an oil burner.
Eclipse Fuel Engineering Co.

5. Sideboom

Midwestern Manufacturing has added a new unit to its line of hydraulically operated sidebooms for small crawler tractors. The new model is designed for attachment to the Case-Terratrac 600 industrial crawler tractor with 60-in. gauge tracks.
Midwestern Mfg. Co.



6. Flare stack pilot

An automatic photo-sensing device for safety control is featured in a new flare-stack pilot. Introduced by Automatic Butane Gas Co., the "Ignito-Matic" is being used for gas purging. It has a low fuel consumption of only 10,000 Btu per hour. Design of the burner and combustion chamber makes the pilot stable in winds of highest velocity.
Automatic Butane Gas Co.

7. Cement softener

Chem-Break, a complex nitrogen chemical, exerts a solvent action on portland cement and other masonry. Here is how the L-R-V Chemical Co. product works: After the Chem-Break is dissolved in cold water, it is poured onto concrete surface. The surface is broken slightly with a jack hammer, and the Chem-Break solution is added to the break. Chem-Break then softens the concrete.
L-R-V Chemical Co.

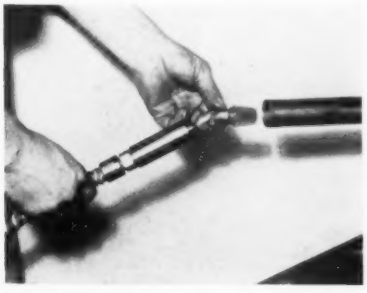
8. Rotisseries

Three distinct rotisseries are available on Roper ranges: (1) top-of-range, (2) in the broiler, and (3) in the oven. The top-of-range Rotis-O-Grill is offered on

three 36-in. models. Twin radiant burners eliminate splattering. The boiler unit is a 3-spit Rotomatic rotisserie on 40-in. models. A Thermospit rotisserie can be had in a 30-in. Gourmet and in one built-in oven.
Geo. D. Roper Corp.

9. Motor valve

Pressure may be applied to either or both sides of the diaphragm in Kimray's new double-acting motor valve. The "DA" motor valve is spring loaded to close against approximately 6 psi upstream pressure. It has a single soft seat, full line opening, to insure tight shutoff. The series includes valves from ¾-in. through 6-in. pipe sizes.
Kimray Inc.



10. Pipe cleaner

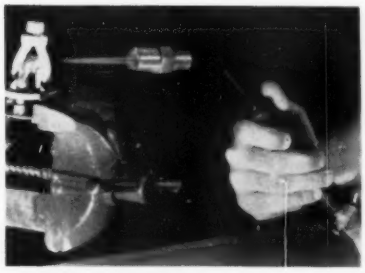
Thick or thin, hard or soft scales can be removed by this cutter head designed by Thomas C. Wilson Inc. The threaded cone cutter is mounted on a standard universal joint that aids scale removal and keeps cutter flutes clean by a knocking action. In conjunction with its companion brush head, this equipment makes 22- to 24-ft pipe lengths serviceable in four minutes.
Thomas C. Wilson Inc.

11. Shock-absorbing breaker

Le Roi's new heavy weight breaker, the LB92, features a shock-absorbing handle. It is available as a paving breaker, a sheeting driver, or a spike driver. Tests show 55 per cent of the shock and recoil are absorbed by the new handle. Nearly all vibration and shock are eliminated from the operator's upper arms, shoulders, and head.
Le Roi Division

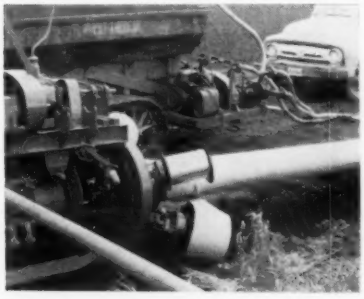
12. Shopcoat

Dresser's Red-D shopcoat gives over six months of protection against corrosion for pipe couplings. The red coat resists dirt adherence, and any grease or oil accidentally spilled on Red-D can be removed with gasoline or carbon tetrachloride without affecting the shopcoat. Dresser reports the shopcoat is compatible with more than 95 per cent of the field coating systems in use on pipelines.
Dresser Manufacturing Division



13. Hand torches

Flexibility, controlled flame characteristics, and long life are among the features of a new line of gas-fired hand torches. Five standard sizes provide heat releases from 500 Btu per hr to 32,800 Btu. A die-pressed, kiln-fired perforated refractory screen combines with a heat-resistant alloy pilot ring to produce an effectively piloted spear flame, allowing wide turn-down without flame blowoff and flashback hazard.
Selas Corp. of America.



14. Mummy wrap

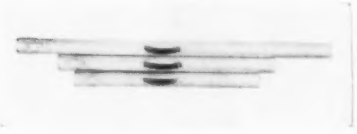
Trenton Corp.'s coating and wrapper—"Mummy-Wrap"—is now being applied with one combination machine that cleans, coats and wraps simultaneously. Trenton Innercoat microcrystalline wax requires no primer. The hot wax is flooded onto the pipe directly after the cleaning operation. It is then over-wrapped with Mono-Ply plastic wrapper and 80-lb Kraft paper.
Trenton Corp.

15. Pipeline auger

Finger-tip-control hydraulic power is featured in a new self-powered portable pipeline auger. Moorlane's auger is designed to bore holes under streets, highways and railroads for gas, oil, water and other lines. This self-contained boring unit is the only piece of equipment needed to bore holes for 2- through 10-in. pipe.
Moorlane Co.

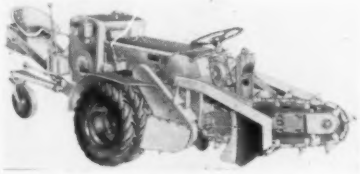
16. Weld deoxidizer

Repeat cleaning of steel joints prepared for welding is eliminated with Weldaluminite, a new product from Spekaluminite Co. The product acts as a weld deoxider and "deporosite." The company believes it is the only rust preventive that need not be removed prior to welding. Porosity is reduced in all welding of carbon and alloy steels as Weldaluminite simulates—at the weld—the mill steel killing operation.
Spekaluminite Co.



17. Map case

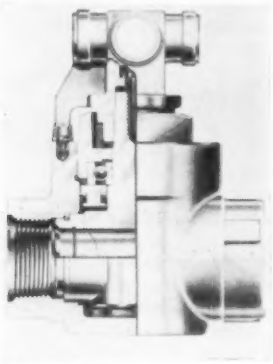
Rolled maps, drawings, plans and blueprints can be carried or shipped in new lightweight, tamperproof aluminum map-carrying cases. The 3-in. Saf-Tee case, designed by Scott-Rice Co., is available in three standard sizes, holding rolled subjects up to 60 in.
Scott-Rice Co.



18. Rubber-tired ditcher

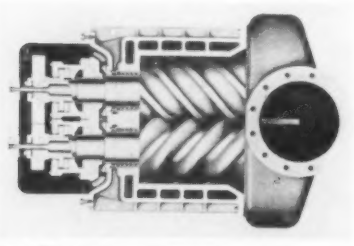
Designed for narrow trenching for underground placement of gas lines is Barber-Greene's new 2-A rubber-tired ditcher. The ditcher can dig up to 40 in. deep. It may be equipped with either a Chisel tooth

bucket line digging 3 or 5 in. wide, or a Hook tooth line digging 3½ to 5 in. wide.
Barber-Greene Co.



19. Plug valve

The Graham plug valve, now being manufactured and distributed by the Texsteam Corp., features a self-cleaning action. When the valve is at the half-open position, a flow is established in all the clearance areas that completely flushes out any material that may be trapped there. This non-lubricated valve, with full-opening or round port, has many applications for the control of gas, water, oil, etc.
Texsteam Corp.



20. Rotary compressor line

Fairbanks-Morse is producing a new line of rotary compressors. The positive displacement unit provides high efficiency, savings in size and weight, smooth operation, low maintenance, and oil-free output. With a standard capacity range of 800 to 13,000 cu ft per minute, the line is designed for continuous, heavy-duty service
Fairbanks-Morse

21. Heating plant

Hydrotherm's Multi-Temp heating plant uses an entirely new concept in the use of gas for heavy-duty Hydronic heating. Now it is possible to modulate gas input automatically with changing load conditions without impairing boiler efficiency. Full input is used only for peak loads and when warming up from a cold start. At other times, input is kept to a fraction of full capacity, in accordance with actual heating demand.
Hydrotherm Inc.

22. Pipe-fitting package

An assorted package of pipe fittings—50 of the most used fittings—is available from Union Malleable. The "Thrifty Fifty Pak" is a carry-all tray divided into bins for each group of fittings.
Union Malleable Manufacturing

TRADE LITERATURE

23. Line pipe

National Tube's seamless, expanded seamless, electric weld, and continuous weld line pipe are covered in a generously illustrated 32-page bulletin. Manufacturing process for each type of pipe is illustrated, and complete specifications and general information are presented.
National Tube Division

24. Two-way radio

"You and Two-Way Mobile Radio" tells the story of the service rendered by this means of communication. The 20-page illustrated booklet is a reference primer on the entire field of 2-way radio.
Motorola Inc.

25. Valve regulators

Functions, applications and operation of Rockwell-Nordstrom valve regulators with Republic controls are the subject of a new 8-page illustrated bulletin. Included in Bulletin 1098 are regulation capacity tables for the complete line—6 in. through 16 in.
Rockwell Manufacturing Co.

26. Sales producers

Twenty-three prize-winning demonstrations of Robertshaw's Thermal Eye are presented in a new 20-page illustrated booklet. Presented are the best sales-producing ideas selected from hundreds of entries in two national contests sponsored by the company.
Robertshaw-Fulton Controls Co.

27. Pipe rotators

Two pipe rotators for welding and flame cutting pipe are presented in a new 4-page bulletin. One, the "Peck Jr.," is a portable unit for pipe up to 5 in. The other is a heavy-duty model for pipe up to 36 in. in diameter.
Cecil C. Peck Co.

28. Product bulletin

American Meter Co. has two new bulletins describing products that have just been completed and are now available. Bulletin 101 covers the Reliance temperature booster regulator. Discussed in Bulletin 308 is America's positive meter connections, insulated and regular.
American Meter Co.

29. Digger

The Go-For-Digger, which digs up to 800 ft an hour forward—and also digs backward—is described in literature. Improvements incorporated in the 1958 model are presented, together with illustrations of the digger in action.
Go-For-Digger Trenching Machine

30. Meter Tube

Daniel Flangnek standard meter tubes are presented in a 20-page catalog (Section D). Formerly custom items, meter tubes can now be ordered as standardized components of gas and oil flow-measurement systems direct from the Daniel catalog.
Daniel Orifice Fitting Co.

31. Gas main coupling

Pipe Fabricating & Supply Co.'s Term-X safety coupling is discussed in a new catalog sheet. With the Term-X, a gas system may be extended as desired, with the pressure on, with complete safety, and without entering customer's premises for shutdown or inspection of results.
Pipe Fabricating & Supply

32. Multi-purpose valve

A multi-purpose valve, which operates both as a plug and check valve, is described in literature from Frank Wheatley Supply Co. The Plugaroo is a non-lubricated plug valve which opens and closes with a quarter turn.
Frank Wheatley Supply Co.

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GAS DIGEST

33. Kitchen care

Easy-to-follow instructions on the proper care of ovens, broilers, and other gas-burning hotel and restaurant kitchen equipment are presented in a chart from Gas Consumers Service. Designed for easy posting, the GSC chart shows how to avoid unnecessary maintenance costs, what cleaning and other maintenance jobs to do regularly, and when to do them.
Gas Consumers Service

34. Storage files

Just published by Diebold Inc. is a 16-page, two-color catalog covering the company's comprehensive line of steel storage files. Illustrations show the wide range of sizes and styles in which the steel files are available. Included also are before-and-after photos showing how Diebold files have modernized record storage for many companies.
Diebold Inc.

35. Electronic computers

One of the most important advances to date in the use of electronic computers by business is described in a 115-page manual from Remington Rand Univac division. The system is called Flow-Matic. It makes it possible to communicate with computers in the English language instead of with mathematical symbols.
Remington Rand Division

36. Cycloidal blowers

Roots-Connersville's complete line of cycloidal blowers for vacuum service are covered in a new bulletin. Full information on construction and technical data on capacities and ratings are included in the bulletin.
Roots-Connersville Blower

37. Data processing

A complete literature package is offered by Taller & Cooper Inc. on its Data Processor. The package consists of a four-page folder describing and illustrating the operation and features of the desk-top machine, specifications, and a selection of application data sheets.
Taller & Cooper Inc.

38. Engine advancements

The complete line of Nordberg four-cycle, V-type engines is described in a new two-color, 18-page bulletin. Operated on diesel, Dual-fuel or spark-ignition gas, the engines described are available in 12 or 16 cylinders with 13- or 13½-in. bore and 16½-in. stroke.
Nordberg Manufacturing Co.

39. Pipeline surge

Detailed information on Union Switch & Signal's pipeline surge protection system is available. This all-relay, self-monitoring system automatically protects pipelines and pumping stations from dangerous line surges. Also available is product information on the company's packaged pipeline control system.
Union Switch & Signal Div.

40. Pipe fittings

Ductile iron pipe fittings are the subject of an eight-page illustrated catalog from Kuhns. In addition to specifications on the "K" line of fittings, the catalog offers comparative physical properties of various pipe fitting metals. Data on impact testing are also presented.
Kuhns Brothers Co.

41. Utility tractors

Trenching, loading, and dozing machines—complete ready-for-work units mounted on Case 34- and 42-hp Utility tractors—are described and illustrated in eight new publications.
J. I. Case Co.

42. Auxiliary power

How a major gas company saves thousands of dollars in recalibrating delicate and expensive instruments with the use of Onan standby electric plants is discussed in a publication from D. W. Onan.
D. W. Onan & Sons Inc.

43. Gas venting

A color slide film from William Wallace tells about "Heat in Harness: The Story of Gas Venting." The film covers popular misconceptions concerning venting, recent important scientific advances in the field, and the contribution of correct gas venting to total gas heat comfort.
William Wallace Co.

44. Gas-fired incinerators

Specification sheets for three recent additions to the Waste King indoor incinerator line are available. Complete specification data, photos, and cutaway drawings covering the three models, including the new smokeless, odorless unit, are presented.
Waste King Corp.

45. Heat diffuser

An informative brochure explains Carrier's new line of direct-fired heat diffusers. The illustrated booklet describes the various installations in which the space heating plant is featured as a low cost central system for schools, churches, warehouses, and other large-area buildings.
Carrier Corp.

46. Gas turbines

Two catalogs describe the latest developments in gas turbine design. The first, a 28-page, illustrated brochure, gives complete engineering and performance data on the Mark TA model, a compact 1150-bhp gas turbine. A six-page brochure describes Clark Models 302 and 305 gas turbines.
Clark Bros. Co.

47. Simplified computer method

A four-page bulletin describes the unusual features of Bendix Computer's new programming method. The Intercom 1000 has been designed for use with the Bendix G-15 general purpose digital computer and is a major simplification in the process of writing instructions to a computer.
Bendix Computer Div.

48. Plastic pipe

A new rigid plastic pipe which can be used at high operating pressures and temperatures has been added to Carlon Products line. Literature describes the plastic pipe, which is made from an improved Kralastic resin. Sizes range from ½ in. through 6 in.
Carlon Products Corp.

49. Data processing

A four-page bulletin describes Beckman's Model 123 data processing system. The 123 is a standard, 100 channel data logger featuring pinboard programming and all solid state construction. Photos and specifications highlight the publication.
Beckman Systems

50. Service bodies

Holan Corp.'s all-purpose commercial service bodies for use with ½- to 1½-ton chassis are discussed in a 4-page brochure.
Holan Corp.

from page 66

Contractors offered aid

Southern Union Gas Co., in a program designed to help contractors minimize risk of damage to underground facilities during construction and excavation, has published a booklet entitled "Avoid Personal Injury and Property Damage."

The Dallas-headquartered company points out that in addition to expensive repair costs, damage to utility lines also can create hazards to life and private property. The booklet urges contractors to contact the gas company for help in locating pipelines in advance of construction work.

Regulation of city-owned utilities under study

Pros and cons on regulation of municipally owned utilities are being voiced by West Virginia's legislature.

Wheeling City Solicitor George Bailey contends that local bodies, subject as they are to political pressures, could exercise adequate control over municipal utilities. Such utilities, he holds, should not be subjected to the same set of state public service commission rules that govern privately owned utilities.

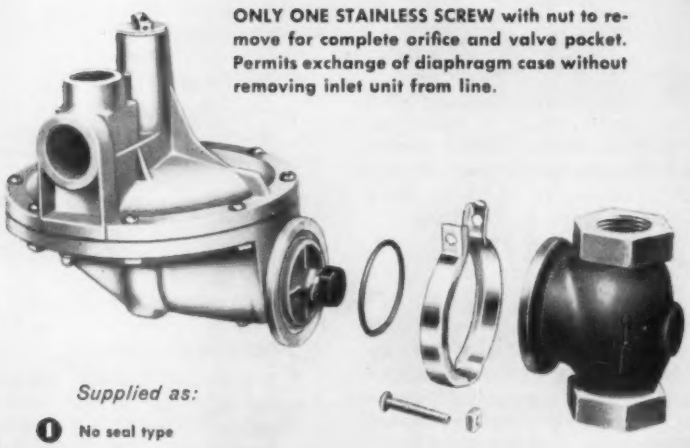
Mayor John H. Camp of Little Westover advocates, however, continued state agency control over rates of public utilities operated by municipalities. "It's the only body we can turn to for advice," he declared.

REYNOLDS

NRT-8010 SERIES

New House Service Regulator

NEW ALUMINUM BODY AND TOP
CAST IRON INLET UNIT
V-TYPE STAINLESS STEEL BAND



ONLY ONE STAINLESS SCREW with nut to remove for complete orifice and valve pocket. Permits exchange of diaphragm case without removing inlet unit from line.

Supplied as:

1. No seal type
2. No seal type with automatic cutoff
3. Internal diaphragm operated relief valve for complete over pressure protection
4. Internal diaphragm relief and automatic cutoff

REYNOLDS REGULATOR CO.
ANDERSON, INDIANA

Petroleum chemistry and refining covered in book

Volume 1 of "Advances in Petroleum Chemistry and Refining" has been published by Interscience Publishers Inc., 250 Fifth Ave., New York 1. It is priced at $13.50 per copy.

Edited by Kenneth A. Kobe and John J. McKetta Jr., both professors of chemical engineering at the University of Texas, the book presents a series of critical evaluations of new developments in petroleum refining and in petro-chemicals.

The 641-page, hard-bound book is divided into five groups: (1) economics and future trends; (2) unit operations and design; (3) refining processes; (4) petro-chemicals; and (5) mechanical equipment.

LPG storage planned

Minneapolis Gas Co. plans to build a $1 million propane storage plant in New Hope, west of Minneapolis.

According to Kenneth W. Pearson, vice president and manager of the suburban division, the new plant will eventually have 60 tanks on a 12.8-acre tract. It will be the company's second propane storage plant. The other, in operation since 1954, is at Golden Valley.

Florida properties sold

South Atlantic Gas Co. is selling its Orlando and Winter Park, Fla. operating properties and its Jacksonville Gas Corp. holdings to the Houston Corp., builder of the Texas-to-Florida pipeline.

South Atlantic president, H. Hansell Hillyer said the sale price was approximately $2.1 million. Under the new setup, Houston Corp. will serve natural gas to all of Florida east of Tallahassee.

Baso, 3M sign agreement

Under terms of a recent agreement with Baso Inc., Minnesota Mining & Manufacturing Co. will conduct certain research and development programs involving thermoelectric materials and devices formerly conducted by Baso.

Baso will continue the development and sale of a variety of thermo-electric generators, with emphasis on devices for the control of gas-fired and other fluid fuel burning apparatus. Patents and patent applications purchased by 3M relate to thermo-electric devices and materials with applications outside the fluid fuel burning field.

Records broken at school

The third annual Appalachian underground corrosion short course set new attendance records. Corrosion engineers and technicians from 29 states and Canada attended the three-day meeting held at West Virginia University.

Officers of the general committee were chosen for the coming year. They are: general chairman, Charles L. Dey, Koppers Co.; program chairman, Charles M. Rutter Jr., Equitable Gas Co.; publications chairman, T. W. Watson, Socony Mobile Oil Co.; exhibits chairman, George G. Campbell, West Virginia University; publicity chairman, John H. Alm, Dearborn Chemical Co.; and registration chairman, R. E. Hanna Jr., West Virginia University.

Speakers guide available

Step-by-step procedures for setting up a speakers' bureau are outlined in a new kit prepared by the AGA public information bureau.

The 16-page how-to-do-it booklet gives practical pointers on how to get started, the methods of selecting and training company speakers, and suitable subject matter and techniques. Also included are several sample speeches easily adaptable for local presentation, plus statistical and background information on the gas industry.

SNG • News Notes

Northern Illinois Gas Co. plans to develop an underground storage field on a pilot basis at Troy Grove

design simplicity . . . accessibility

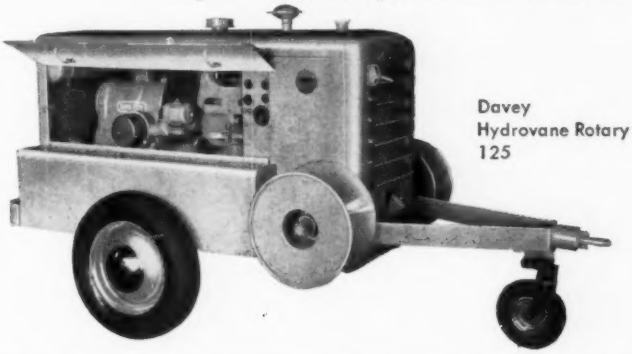
50% fewer working parts

make the

HYDROVANE DAVEY KENT OHIO U.S.A.

Davey Hydrovane Rotary

today's best compressor investment!



Davey Hydrovane Rotary 125

Take one quick glance at the new Davey Hydrovane Rotary. You'll note there are no complicated pipes, pulleys, tubing or plumbing.

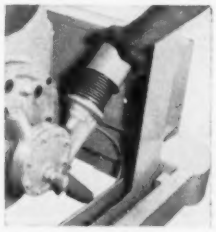
Every part is readily available for inspection. Daveys can be serviced by any mechanic. No special tools—only pliers, wrench and screwdriver are needed.

Before you buy—see Davey. 50% fewer working parts means greater operating efficiency, reduced maintenance expense, longer life.

AA-7060

UNMATCHED ACCESSIBILITY

Oil separator, relay valve, filter, shaft and pump are "easy-to-get-at".



It's a cinch to remove oil filter cover for cleaning.

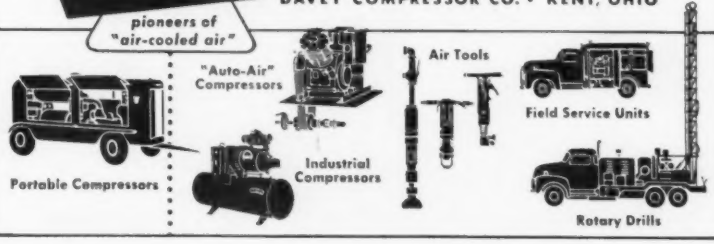
Segmented rotor vanes can be easily inspected or replaced in the field...in minutes.

DAVEY

pioneers of "air-cooled air"

Ask for Bulletins E-267 and 268!

DAVEY COMPRESSOR CO. • KENT, OHIO



have been approved by the Illinois Commerce Commission (see GAS, July, page 61.) If pilot operations are successful, some 8 billion cu ft of gas may be stored there. Northern Illinois vice president E. D. Sheehan said "if all tests we plan to make . . . bear out preliminary findings, this underground gas storage project could prove of some use to us during the 1960-61 winter."

The Long Beach (Calif.) Gas Department is constructing one of the largest gas holders to be built in the U. S. since 1951. It will be 214 ft in diameter, 173 ft, 10 in. high. Compressor facilities at the plant are also under construction. General American Transportation Corp. is to build the holder. M. A. Nishkian engineered the project.

The 1958 revision of Bulletin TS-343, "Tentative Standard Methods for Testing Absorption Oil" has been published by the California Natural Gasoline Association. With the use of low molecular weight absorption oils for increasing absorbing capacity, lean oil losses into the absorber residue gas have become a significant factor. This bulletin includes two new methods for estimating oil losses to the residue gas. Prices for the publication are $3 for non-members and $2 for members. It is available from CNGA, 510 W. 6th St., Los Angeles 14.

Arkansas Louisiana Gas Co.'s plans to build a gas system to serve three Arkansas communities has PSC approval. The $574,500 system will serve Tupelo, Patterson, and McCrory. Money for construction will be supplied from revenue bonds issued by the cities. The system will be leased to ALG for 25 years and the firm has a purchase option.

East Ohio Gas Co. President Robert W. Ramsdell congratulates Jerry B. Anderson (center) and James L. Frink, after presenting them with East Ohio four-year tuition-paid scholarships to Illinois Institute of Technology. East Ohio's scholarship program is designed to meet the need for qualified engineers in the natural gas industry. The youths will attend IGT, working toward bachelor of science degrees in engineering.

Reeves Bros. Co. has completed the move of its New York offices from 54 Worth Street to 1071 Avenue of the Americas. The last three divisions to move were the

Branding Time

Time to "Tally the Herd" and "Round up the Strays".

Gas companies, nationwide, profitably use Southern Cross Foresters gas leak "Round-up" services . . . leak location surveys and when needed, fully equipped fully trained repair crews.

SOUTHERN CROSS FORESTERS

Atlanta 6, Ga. MElrose 4-4227

Vulcan Sales, Plastic Sales, and industrial sales. Earlier, the general and administrative offices, the Greige sales division and the Finished Goods Sales division moved.

E. C. Jacquel, Peoples Natural Gas Co., Pittsburgh, has received an award from the American Institute of Architects. The company's architectural representative was honored for a manual he prepared and presented to the local chapter of AIA.

Berry Hydraulics, Pittsburgh, appointed T. F. Hudgins & Associates Inc. as sales representatives in the Houston area.

Iroquois Gas Corp., Buffalo, is planning storage facilities on the Cattaraugus Indian Reservation in New York. The company is seeking PSC approval of its plan to cross the land with a storage and transmission land. Vice President Louis R. Reif told the commission that his company and the Seneca Indian Nation have agreed on $5000 annual rental for a 16-in. line from storage in Nashville to Buffalo.

Procedures for maintaining, protecting, recharging and inspecting fire extinguishing equipment used throughout the gas industry are covered in the new FEMA "Handbook of Safety Codes." Mandatory and recommended procedures to be

Whirlpool Corp. is using this comprehensive sales training aid on its new RCA Whirlpool gas refrigerator. Portions of the multi-paged flip chart are animated and illuminated. A large section is devoted to cataloging the outstanding innovations of the gas refrigerator. Fully explained through the use of illumination, animation, and schematic drawings is the gas-fired absorption method of refrigeration.

how the newest

These days, when favorable earnings reports are a rarity, you'll find one of the secrets of management success is a relentless program of cost reduction. Diebold can show you a program that has *increased productivity* as its target.

record-handling

Use Modern Methods To Do The Job: Increased clerical productivity is virtually an *automatic* benefit when you put the motorized efficiency of Diebold Rotary Files to work. Keyed to modern record-handling procedures, these new files accelerate record processing. Your personnel become more efficient and productive!

idea can help you

A further economy lies in the ability of Diebold Rotary Files to accommodate your present records . . . including tab cards and tissue copies. No time-wasting, costly transcription necessary. And records are held upright constantly . . . no belts will wear or fray your records. Another advantage: the complete top of the record can be used for guiding.

SLASH

Diebold Rotary Files are made in over a hundred different types . . . you can be sure of getting the right one for your application. And you're offered a wide choice of operating controls. Let Diebold show you how to cut costs through increased productivity. A newly-published brochure details the *Diebold Rotary File* story. Your free copy will be sent on request. Mail coupon today!

clerical costs!

DIEBOLD

INCORPORATED

CANTON 2, OHIO

Gentlemen: Please send me your new brochure on Diebold Rotary Files.

Name_____ Title_____

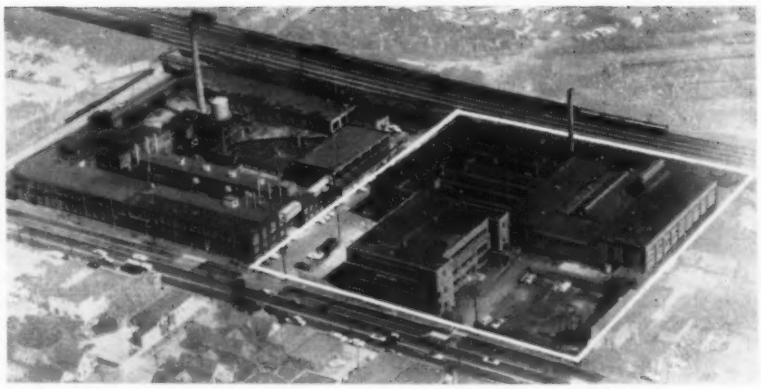
Company_____

Address_____

DIO-216 City_____ Zone____ State_____

followed to assure long life and efficient service from various systems are covered. The handbook is available from the Fire Equipment Manufacturers' Association, 1 Gateway Center, Pittsburgh 22. There is no charge.

Koehring Co., Milwaukee, has bought Ka-Mo Tools Inc., Cicero, Ill., manufacturer of special earth drilling and boring equipment. The Ka-Mo Tools business will become a department of Kwik-Mix Co., a division of Koehring.



Hays Manufacturing Co is now occupying a 115,000-sq ft addition to its plant in Erie, Pa. The modern factory and office space, adjacent to the original buildings, are in the right-hand portion of the photo.

Intermountain Gas Co., serving Boise, Pocatello, Idaho Falls, Twin Falls, and Nampa, Idaho, has placed $3 million of first mortgage bonds with institutional investors. Proceeds will be used for construction. Intermountain's system supplies customers in 30 counties in southern Idaho, an area containing about 60 per cent of the state's population.

The largest enrollment in summer session at the Institute of Gas Technology has been recorded in this year's session. A total of 119 men, gas engineers from all parts of the U. S. and Canada, and from England, Pakistan, and Hawaii, are enrolled in the seventh summer session.

Several distributors have been appointed by Chambers Built-Ins Inc., Chicago. They will handle Chambers' complete new line of matched and packaged built-in kitchen appliances. Among distributors are Allen Co., Pasadena, Calif.; Howard Palmer Builders Hardware & Specialties, San Diego, Calif.; Mountain States Distributors, Albuquerque; A. Y. McDonald Mfg. Co., Sioux City, Iowa; Paulsen Kitchen Center, Waterloo, Iowa; Northwest Builders Products, Minneapolis; Porth-Early Co., Sioux Falls, S. D.; Hicks Distributing Co., New Orleans; Noland Co., Atlanta; Royal Distributing Co., Little Rock; and Sharpe's Inc., Mobile.

leaky gas joints?

Excavating hundreds of feet of gas distribution lines just to repair leaking bell-and-spigot joints is a costly job. . . . It's an annoyance to your customers, too. There's a better way to do the job.

To solve the problem of natural gas leakage due to dried out joint packing, gas utilities have turned to CARBOSEAL Anti-Leak. By swelling the jute and hemp fibers as much as 44 per cent of their dry volume, CARBOSEAL Anti-Leak can *eliminate leakage* . . . with an estimated effective life of up to 25 years!

CARBOSEAL Anti-Leak is easy and inexpensive to use. Find out how other gas utilities have profited from this treatment. Write today for the booklet "Stop Gas-Main Leakage with CARBOSEAL Anti-Leak" . . . and the 16 mm. color-sound motion picture "CARBOSEAL Anti-Leak Stops Gas-Main Leakage" . . . address Dept. B.

CARBOSEAL ANTI-LEAK

UNION CARBIDE CHEMICALS COMPANY

Division of UNION CARBIDE *Corporation*

30 East 42nd Street, New York 17, New York

In Canada: Carbide Chemicals Company, Division of Union Carbide Canada Limited, Montreal

The terms "Carboseal" and "Union Carbide" are registered trade-marks of Union Carbide Corporation.

GAS·PEOPLE

John Rutherford
Ohio Fuel

Jack Bieber
Ohio Fuel

JOHN M. RUTHERFORD and JOHN A. BIEBER are newly elected vice presidents of Ohio Fuel Gas Co., Columbus. Mr. Rutherford, who was Ohio Fuel treasurer, was elected vice president in charge of financing and accounting. Mr. Bieber is in charge of wholesale sales. WILLIAM J. CURNOW was elected treasurer and LUTHER S. WILLIAMS assistant treasurer.

William Curnow
Ohio Fuel

Luther Williams
Ohio Fuel

S. L. CRAWSHAW has been elected a vice president of Philadelphia (Pa.) Gear Corp. Mr. Crawshaw, with the company since 1955, will direct Philadelphia Gear's new high precision gear grinding activities.

J. P. GASSER is the newly appointed executive vice president of Dresser Industries Inc., Dallas. Mr.

S. L. Crawshaw
Philadelphia Gear

J. P. Gasser
Dresser

Digs up to 26 INCHES WIDE

...5¾ feet deep

Here's a wide range of work capacity for opening intra-city transmission lines, or digging additional gas distribution and service lines in town. Parsons® 150 wheel Trenchliner® digs 16 to 26 inches wide, at depths to 5¾ feet. 30 digging speeds, up to 25 feet per minute, assure maximum trench production at every width, depth, in all soil conditions.

Hydraulic wheel-hoist

A hydraulic ram on vertical mast raises and lowers digging wheel with fractional-inch accuracy — maintains close grade tolerance at any depth. Separate hydraulic ram tilts the mast, balances weight of wheel forward when traveling or trailer-loading. Dual-purpose friction clutch drives the digging wheel — and automatically slips when overloaded. This action protects machinery against sudden shock-loads.

To handle a wide-range of soil conditions, Trenchliner has cast-steel buckets with self-sharpening, reversible "Tap-In" teeth — or quick-change gumbo buckets. Shiftable, reversible belt conveyor deposits spoil on either side of trench. Want to know more about the 150 wheel-type Trenchliner? Your Parsons distributor has complete details — call him today or write for catalog.

Three types of treads are available for work and travel over any surface. Standard grouser-type crawlers have 16-inch treads. Optional street pads can be added. For special jobs, 150 has optional 12-inch flat shoes. (4 other wheel-types, and 5 ladder-type Trenchliners available, including rubber-tired Trenchmobile.

mail to: PARSONS Company, Newton, Iowa — *for literature on 150 wheel-type Trenchliner*

NAME ..... TITLE .....

COMPANY ..... DIV. .....

STREET .....

CITY ..... STATE ..... P811 GAS

Also interested in ☐ *ladder-type Trenchliners . . .* ☐ *rubber-tired Trenchmobile®*

PARSONS TRENCHLINERS
A division of Koehring Company

Gasser, long identified with Seaboard Oil Co., formerly served as executive vice president and member of the executive committee. As one of three Dresser executive vice presidents, Mr. Gasser will direct the activities of Lane Wells, Ideco Inc., Magnet Cove Barium, Security Engineering, Well Surveys, Dresser Dynamics, Southwestern Industrial Electronics, Hermetic Seal Transfer Co., and Dresser's Turbodrill Division.

H. B. KEENLEYSIDE has been elected a director of Union Gas Co. of Canada Ltd.

Alabama Gas Corp., Birmingham, has reorganized its gas department. It will remain under the direction of J. H. CHENERY, vice president in charge of sales. EARL L. DOSTER, former manager of the Tuskegee plant, is now general sales manager. EDWARD E. MCGRAW has been promoted to manager of advertising and sales promotion. New district sales managers are S. M. ERSKINE, Birmingham; C. R. HARE, northern district with headquarters in Anniston; and ALLEN BRICKEN, southern district, with headquarters in Montgomery. VIRGINIA LOWERY, formerly home economist in Montgomery, is now home service director.

ARCCO
ARCCO CANNON NEVER-DRY PEN
Writes for Months
REPLACES OTHER MAKES • USES REGULAR INKS
Regardless of pulsations or other causes of ink failures this new Never-Dry Pen will make clean and complete records. Ink supply lasts for several months without refilling reservoir. Capillary tube from ink bottle placed in instrument case feeds pen with continuous flow. Closed system sealed from atmosphere prevents clogging and dirt accumulation.
Weight of pen is constant at all times thus insuring extreme accuracy. No slopping or dripping. Stainless steel construction—no corrosion. When ordering, specify make and type of recording instrument.
AMERICAN
RECORDING CHART CO.
3113 E. 11th St. • Los Angeles 23, Calif.
$6.00 each Net
Send for quantity prices
SEND FOR BULLETIN No. 110-R1

In a major reorganization of its sales division, Crane Co., Chicago, named WILLIAM B. GILMOUR general manager of merchandising and DARRELL R. NORDWALL general manager of sales. Mr. Gilmour was associated with Inland Steel Co. for 22 years in various sales capacities. Since 1950 he was manager of its commercial research division. Mr. Nordwall formerly managed Crane's West Coast sales district headquartered in Los Angeles. Succeeding Mr. Nordwall in Los Angeles as district manager is ROBERT E. PENNEY. Other changes include F. C. AKERS to manager of commercial research and advertising; W. A. BURBINE to manager of heating product merchandising; M. F. DUCHATEAU to manager of plumbing products merchandising; and C. H. LOVELACE to manager of industrial product merchandising.

East Ohio Gas Co., Cleveland, has four new board members. They are: GEORGE P. BINDER, chief engineer; JOHN S. MCELWAIN, general sales manager; CHARLES E. GALLAGHER, manager of distribution for the southern region; and THOMAS J. NOONAN, manager of distribution for the northern region.

T. CORTLANDT WILLIAMS, president of Stone & Webster Engineering Corp., New York, has been elected a member of the board of trustees of Bucknell University in Lewisburg, Pa.

Three vice presidents and a secretary-treasurer have been appointed by Crutcher - Rolfs - Cummings Inc., Houston. KENNETH DEFENBAUGH is vice president and general manager; C. E. HATCHER also was named to a vice presidency; and JACK SCOTT, formerly sales and service manager, is vice president in charge of sales and service. W. C. CHERRY, the newly appointed secretary-treasurer, was formerly chief accountant and comptroller.

DALE DELONG and R. F. HUGHES have joined the sales engineering staff of Grove Valve & Regulator Co., Oakland, Calif. Mr. DeLong was assigned to the New Orleans area. Mr. Hughes will be headquar-

tered in Tulsa. B. W. BOWDEN has transferred from the company's Houston office to Lafayette, La.

GERRY POWELL has been appointed sales manager of White-Rodgers Co., St. Louis, Mo. He will be responsible for the company's field sales force. Before his appointment as assistant sales manager in 1957, Mr. Powell was manager of the company's Chicago region.

MARVIN F. HALL has been named consulting gas engineer for Ebasco Services Inc., New York. In this capacity, Mr. Hall will be in charge of gas engineering activities for the company.

DAVID H. MCCLAIN has been appointed general manager of Crane Co. branches. He has been administrative assistant for branches since 1957.

Four technical representatives were transferred by Union Carbide Chemicals Co., New York. LORY A. CRISORIO moved to Chicago; D. WALLACE ENRIGHT moved to the Charlotte district, H. ROBERT HUBBS went to the Indianapolis district, and BERNARD HURLEY moved to the Chicago district.

JOHN BRASS JR. has been named auditor of division accounts for Pacific Gas & Electric Co., San Francisco. He takes over from HARRY MCGANN, veteran PG&E auditor, who has held the post since 1947. Mr. McGann, who began his long career with the San Francisco utility in 1916, reached normal retirement age on July 1. However, he will continue with PG&E for a limited time as special assistant to Comptroller L. W. Coughlan. Mr. Brass joined the PG&E staff when it merged with Northern California Power Co. Succeeding Mr. Brass as assistant to the general auditor is LEONARD F. KOPP.

C. E. DUNAHOO has been appointed safety director of San Diego (Calif.) Gas & Electric Co., succeeding the late JAMES E. SMITH.

HOMER LAUGHLIN has left his post as advertising manager of Southern Counties Gas Co. for reasons of health. Mr. Laughlin has been SoCounties advertising manager since 1952. From 1936 to 1952 he was assistant ad manager of Southern California Gas Co.

Several promotions and changes have been made in the sales department of Washington Natural Gas

INSTALLING 15,000 feet of 4" to 8" pipe in the Sundale Subdivision, Washington, Illinois, being built by Richmond Home Builders. Wiegand & Storrer lay approximately 2400 feet of pipe per day.

"We lay 400% more pipe per day" —WIEGAND & STORRER

"In 1956 we replaced a backhoe with a Buckeye '307' ditcher. Now we lay 400% more pipe per day! Our Buckeye ditcher leaves a neat, continuous spoil bank that means easy, low-cost ditch backfilling. We chose the '307' over 3 other makes because it had a hydraulic hoist, simple controls and 3-speed hydraulic conveyor. Maintenance costs have been exceptionally low. We know our Buckeye ditcher was a wise choice."

WIEGAND & STORRER
Rt. 6, Peoria, Illinois

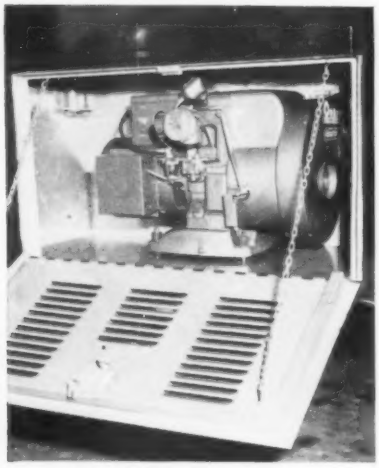
Gar Wood Excavators

Gar Wood Winches

Gar Wood–St. Paul Hoists & Bodies

Gar Wood
INDUSTRIES, INC.
Wayne, Michigan • Findlay, Ohio

ELECTRIC PLANT
NEWS



Charges truck batteries at far less cost... provides A.C. power, too!

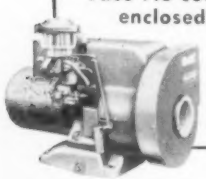
Before the dual-purpose Onan Electric Plant was installed on this maintenance truck, it was necessary to run the 160 H.P. truck engine to charge batteries for communications. Now, the 2 H.P. Onan Electric Plant does the same job . . . saving fuel and engine maintenance.

These battery charging-A.C. combination electric plants are available with 1,000 or 2,000 watts of A.C. output for operating tools and lights. Either size also delivers a full 30 amperes . . . enough to handle battery drain from radio and lighting.

Big savings reported!

One utility makes fuel savings alone estimated at $2.00 per day per truck. Another cites an annual saving of $800.00 per truck. This is based on battery charging output only. In addition, the A.C. output makes possible replacing hand tools with electric tools . . . saving time and money.

Vacu-Flo cooling permits enclosed installations



Vacu-Flo cooling is a low-cost optional feature on Onan air-cooled plants up to 10,000 watts.

Other Onan Models 500 to 200,000 watts A.C., D.C. and Battery Charging.

Write for folder showing 3 Packaged Power Systems

Onan
ELECTRIC PLANTS

D.W. ONAN & SONS, INC.
3038A University Ave. S.E., Minneapolis 14, Minn.

people • *Continued*

A. A. Copetas
Consolidated

Robert Thomsen
Dollinger

J. B. Hansen
Hardwick

W. F. Johnson
Hardwick

Co., Seattle. JAMES BIRD has assumed the new post of administrative assistant to the northern division sales manager; WILLIAM DEARBORN is domestic sales supervisor; J. P. HANDLEY is industrial sales supervisor; CHARLES TEAGUE becomes sales staff heating consultant; GORDON LARSON has transferred to the commercial sales department; and VERNON STRIECK is now industrial sales representative.

ROBERT P. THOMSEN has been named sales manager of the Dollinger Corp., Rochester, N. Y. He succeeds Lewis L. Dollinger, Jr., recently named president of the company. Mr. Thomsen formerly served as advertising manager.

WALTER D. HOWELL has been named manager of commercial, industrial and agricultural sales for Pacific Gas & Electric Co., San Francisco. He succeeds J. H. GUMZ, who has retired after 36 years with the company. Mr. Howell, a veteran of 32 years with PG&E, formerly served as Berkeley district manager and East Bay division commercial manager. Since 1954, he has been manager of agricultural sales and special accounts.

ROBERT C. SMITH is the newly appointed commercial and industrial sales supervisor of the Mystic Valley Gas Co., Malden, Mass. He succeeds A. NELSON PARRY, who has resigned.

L. RENE GAIENNIE has been elected vice president of industrial and public relations of ACF Industries Inc. He succeeds ALBERT L. KRESS, who remains a staff vice president.

HAROLD J. MERILEES, B. C. Electric Co. Ltd.'s public information manager since 1946, has been appointed executive assistant. Mr. Merilees is succeeded as public information manager by PETER C. WOODWARD, former public information director in the Fraser Valley.

JACK SHNABLE has been promoted by Controls Co. of America to the post of West Coast general sales manager. He will headquarter in El Segundo, Calif.

CHARLES PARTHUM has been named sales promotion manager by Bucyrus-Erie Co., South Milwaukee, Wis.

WILLIAM F. JOHNSON is sales manager and J. B. HANSEN is sales promotion manager for Hardwick Stove Co., Cleveland, Tenn. Mr. Johnson has been with Hardwick for the past four years as sales promotion manager. Mr. Hansen formerly was account manager of the Franklin Manufacturing Co.

ARISTOTLE A. COPETAS has been promoted to manager of system gas supply by Consolidated Natural Gas Co. He will headquarter in Pittsburgh. Mr. Copetas succeeds J. J. SCHMIDT, recently named vice president of Hope Natural Gas Co. Mr. Copetas has been assistant manager of gas supply since 1957.

R. ARNOLD E. DAVIDSON, formerly assistant test engineer, has been promoted to test engineer of the Connecticut Light & Power Co., Berlin, Conn. He succeeds JOHN M. JOY, who has retired.

FOSTER E. GROFF has been promoted to northern compressor division superintendent for Ohio Fuel Gas Co. Mr. Groff has been division engineer since 1949.

Following the merger of Peoples Water & Gas Co. of North Miami and the Tampa Gas Co. into Peo-

ples Gas System Inc., several promotions were announced. J. H. O'BRIEN, former treasurer of Peoples Water & Gas, is now comptroller and assistant secretary. R. H. MORRISON JR., former assistant treasurer of Tampa Gas, is assistant treasurer and assistant secretary. J. K. CHASTAIN, former chief accountant at Peoples Water & Gas, is assistant treasurer and assistant secretary. And, J. L. FOLGER, formerly chief accountant at Tampa Gas, is now fiscal administrative assistant.

DeZurik Sales Co. has opened a new Philadelphia regional sales office. WILLIAM DRUMMOND was named manager. The DeZurik Sales Co. is the sales and service organization for DeZurik Corp., Sartell, Minn.

JAMES A. HICKEY has joined Southern Union Gas Co., Dallas, as safety coordinator. Since 1953, Mr. Hickey has served as safety supervisor for Atlanta (Ga.) Gas Light Co.

Southwestern Industrial Electronics Co., a division of Dresser Industries, Houston, has made several staff appointments and promotions. WARREN C. DUNN has joined the company as assistant to the executive vice president. Heading each area of SIE interests in the position of product manager are LOUIS B. MCMANIS, geophysical; FRANK C. SMITH JR., instrumentation; NEWTON E. ARMSTRONG, control; ROBERT L. MCCELVEY, government contract; and ROBERT B. DUSTIN, inter-company and heavy manufacturing. New director of industrial relations at SIE is C. H. STEEL, who has been on the industrial relations staff of Dresser Industries Inc. for two years.

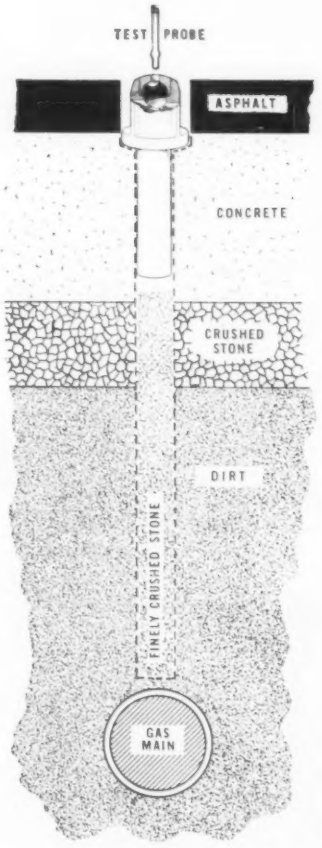
ROBIN A. BELL is the newly elected president of the two Janitrol divisions in Columbus, Ohio, and executive vice president of Surface Combustion Corp. HENRY M. HEYN was elected president of the corporation, succeeding Frank H. Adams, who died on Easter Sunday. Mr. Heyn also was elected president of the Industrial division in Toledo. ALBERT J. BUCKENMYER, secretary and treasurer of the corporation, was elected to the board of directors.

WOODFORD D. MILLER has been named general manager of the Ful-

NEW — HEATH A-T-I (Auto-Test-Insert) Unit provides permanent test hole facility which permits thorough and accurate surveys for leakage control . . .

Designed to facilitate both thorough and rapid location of gas leaks in paved areas, the Auto Test Insert has a self-sealing neoprene insert. Testing for leaks is done instantaneously from a vehicle, without use of tools or removing a cap. A probe is inserted into the A-T-I Unit by a man seated in the vehicle. The Unit is made of cast iron, while top insert plug is a special bronze alloy. Once installed, it requires no maintenance or other attention.

Photo of Heath Auto Test Insert (Pat. Pending) showing exterior ribs at top, to keep installation in place without movement.



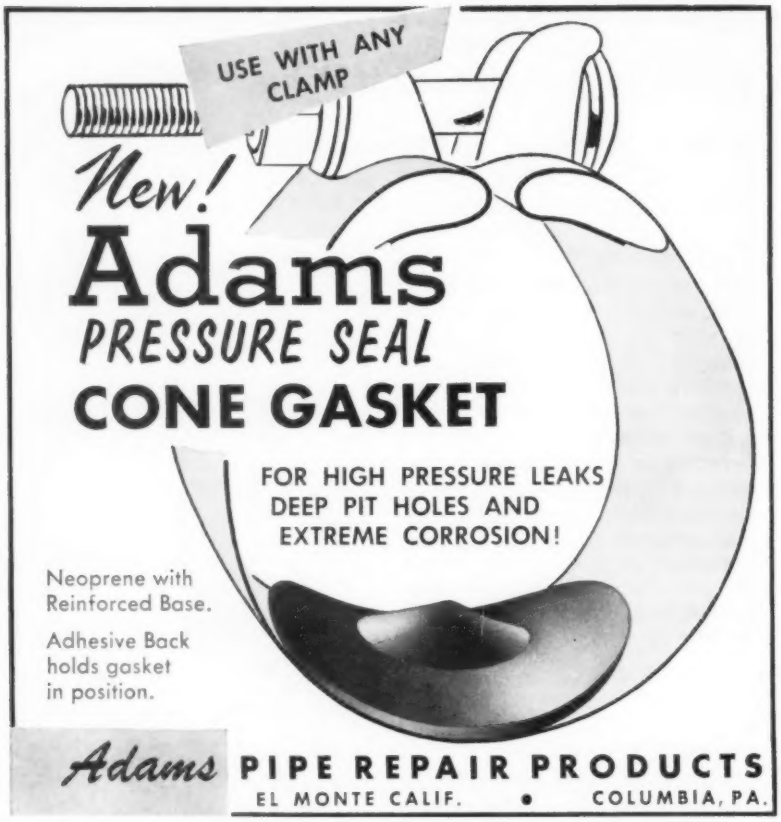
Installation drawing showing Heath A-T-I Unit in pavement. Height of test hole can be adjusted to compensate for repaving, etc.

The A-T-I test hole unit is installed in selected locations along gas lines where frequent drilling of test holes is both costly and hazardous. A probe is inserted through a hole in the bronze top of the unit, forcing open a neoprene diaphragm. A sample of sub-soil atmosphere is taken and the probe withdrawn. Diaphragm springs back to its original position, re-sealing test hole.

Bulletin H-2 completely describes the Heath A-T-I Unit, and includes a typical Block Plan showing how units are positioned in downtown areas. It is estimated that use of A-T-I Units will permit the making of Heath Leakage Control Surveys in 50% of the time required with previous methods.

For information about Heath Leakage Control Surveys, write to:

HEATH SURVEY CONSULTANTS, INC.
573 Washington Street
Wellesley 81, Massachusetts



To Sell Them on Gas
...Sell them
Siegler

Exclusive Features
- Patented inner heat tubes
- Patented built-in blower system

Exclusive Performance
- "Traveling" Floor Heat

FREE...Your Own Merchandising Man

Your Siegler Representative is a full-time, trained specialist in the home heater field. He will show your salesmen how to "sell 'em up" to Siegler, and help you plan your advertising, promotions and demonstrations.

SIEGLER HEATER COMPANY, CENTRALIA, ILL.

GAS Siegler PATENTED AUTOMATIC HOME HEATERS

THE HIGH PROFIT LINE

people • *Continued*

ton Sylphon division of Robertshaw-Fulton Controls Co. in Knoxville, Tenn. Mr. Miller is a director of the company. He replaces Vice President FREEMAN G. CROSS, who will continue at the division in charge of expanded marketing and product development. The division also has named R. E. FITZPATRICK district sales manager in Cleveland.

M. S. MIRANDA, director of public relations and advertising at Dresser Industries Inc., Dallas, was elected chairman of the board of the National Industrial Advertisers Association recently.

Three key appointments were made in the management of Minneapolis-Honeywell's Boston division. C. B. HARRISON, formerly manager of Honeywell's Fort Worth office, has been named to the newly created post of marketing manager. J. A. VITKA, formerly manager of government contract administration, is contract administration manager. And, W. A. ROTE, formerly chief engineer, assumes the responsibilities of director of engineering, heading research and development, pre-production, product and special engineering activities.

Deaths

EDWARD F. BARRETT, former president and chairman of the board of Long Island Lighting Co., Mineola, N. Y., died recently. He was 70 years old. At the time of his death, Mr. Barrett was serving LILCO as a director and chairman of the company's pension committee. He joined Long Island Lighting in 1934 as financial vice president and director. In 1937 he was elected president of LILCO, Queens Borough Gas & Electric, and Nassau and Suffolk Companies. He served as president until 1953. From February 1953 to November 1957, Mr. Barrett was chairman of the board. He resigned at that time to take the post he held at the time of his death. For several terms, Mr. Barrett served as a director and treasurer of the AGA.

DONALD T. HOWELL, assistant secretary and assistant treasurer of United Gas Corp., Shreveport, died recently after a long illness. He was 61 years old. Mr. Howell joined United Gas in 1949. He also held offices with two of United's affiliated companies.

GAS ASSOCIATIONS

Wolfe heads AGA nominee list

Nominated to serve a term as president of the American Gas Association is J. Theodore Wolfe, president of Baltimore (Md.) Gas & Electric Co. At present, Mr. Wolfe is serving as 2nd vice president of the association.

Other nominees: 1st vice president, Wister H. Ligon, president of Nashville Gas Co.; 2nd vice president, L. T. Potter, president, Lone Star Gas Co.; treasurer (renominated), Vincent T. Miles, treasurer of Long Island Lighting Co.

The fifteen men nominated as directors include: Eskil K. Bjork, Peoples Gas Light & Coke; Everett J. Boothby, Washington Gas Light; H. Donald Borger, Peoples Natural Gas Co.; Orville S. Carpenter, Texas Eastern Transmission Corp.; Marvin Chandler, Northern Illinois Gas Co.; Carl E. Cloud, MidSouth Gas Co.; Charles H. Gueffroy, Northwest Natural Gas Co.; William G. Hamilton, Jr., American Meter Co.; W. J. Harvey, Public Service Electric & Gas Co.; Robert A. Hornby, Pacific Lighting Corp.; A. W. Johnston, Boston Gas Co.; Walter T. Lucking, Arizona Public Service Co.; E. Clyde McGraw, Transcontinental Gas Pipe Line Corp.; E. A. Norman, Jr., Norman Products Co.; and Gustav F. Watters, Niagara Mohawk Power Co.

PR achievement award judges named by AGA

Three leaders in the public relations and publications fields will serve as judges in the AGA's second annual public relations achievement award competition.

Kenneth W. Haagensen, president of the Public Relations Society of America and director of public relations for Allis-Chalmers Manufacturing Co.; James L. Macwithey, president of the American Public Relations Society and director of public rela-

THE *FINEST* FOR MODERN GAS DISTRIBUTION SERVICE

NORMAC

Insulating Couplings AND Fittings

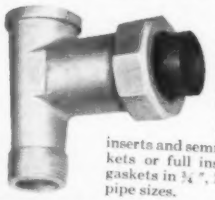
Malleable Couplings

Normac Insulating Malleable Couplings and fittings are available with polyethylene inserts and semi-insulating gaskets or full insulating rubber gaskets.

Malleable Service Ell

The insulating principle depicted above is carried out in all Normac Ells and Tees.

Brass Fittings



Normac insulating Brass compression end Tees, Ells and all compression end fittings are available with polyethylene inserts and semi-insulating gaskets or full insulating rubber gaskets in ¾", 1" and 1¼" iron pipe sizes.

NORTON McMURRAY has specialized for 20 years in the development and production of products solely for the Gas Industry. Whether your plans include modernization, or new, expanded facilities, Normac Gas Distribution Equipment will serve you well.

Insulating Gaskets

The Normac insulating principle incorporates an efficient combination of a polyethylene sleeve and a semi-insulating gasket or full rubber gasket and retainer ring.

New CATALOG

Write for your copy . . . it gives complete details and specifications of NORMAC equipment.

NORTON-McMURRAY Manufacturing Co.

919 North Michigan Avenue

CHICAGO 11, ILLINOIS

Couplings • Meter Bars • Sleeves • Cocks • Bell Joint Clamps • Service Tees and Ells

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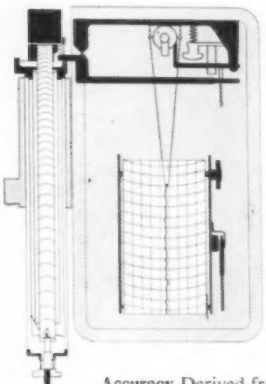
PIPE STOPPERS OF ALL KINDS

SAFETY GAS MAIN STOPPER CO. INC.

GOODMAN — USED SINCE 1897 — 2" HANDLE & LOCKING SLEEVE — GAS MAIN STOPPER

523 Atlantic Avenue
Brooklyn 17, N. Y.

Cable Address GASTOPPER, N. Y.



Sigma Calorimeter

ACCURATE, DEPENDABLE

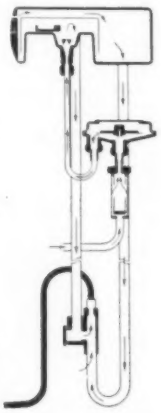
LOW IN COST

Calorific values of all combustible gases from 80 B.T.U.'s and up are read and recorded by the Sigma Mark II Recording Calorimeter. Its economy and performance are unmatched by any other similar instrument.

Accuracy Derived from a unique but simple design. Provides immediate and automatic compensation for wide variations in specific gravity, temperature and atmospheric pressure.

Low Cost Initial cost is extremely low. Compare it. Maintenance is negligible. Drive mechanism is fully jeweled. No other continuously moving parts to wear out. Serviced quickly by unskilled personnel.

Highly Adaptable Records calorific value of natural gas, coke-oven gas, producer gas, blast furnace gas, water gas, L-P gas, coal gas, and many others. Suited for wall or panel mounting. Takes little space. With special equipment can also record between 0-80 B.T.U.'s.



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COSA *National Representatives for Sigma Instrument Co., England*

Cosa Corporation, 405 Lexington Avenue, New York 17, N. Y.

WARRENGAS the Concentrated fuel

GULF GULFTANE LP-GAS

WARREN

PETROLEUM CORPORATION

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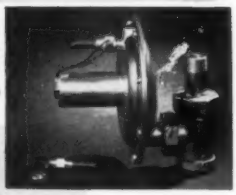
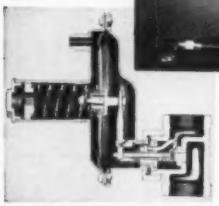
UNIVERSAL

GAS SERVICE REGULATORS FOR CONVERSION OR PRESSURE ELEVATION

A REGULATOR, BREATHER VENT AND CATHODIC INSULATOR IN ONE PACKAGED UNIT





U. S. Patent No. 2,577,480. Other Patents Pending.

TYPE 51-R FOR EVERY INSTALLATION

EXCLUSIVE FEATURES NOT FOUND ELSEWHERE!

Exceptionally high relieving capacity obtained by new type internal relief valve. Remarkable by-pass check valve prevents over-shooting of low pressure and damage to meter.

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UNIVERSAL

CONTROLS CORPORATION

P. O. BOX 13122 WALNUT HILL STA.
DALLAS 20, TEXAS

tions, Bristol-Myers Co.; and Francis X. Welch, editor of *Public Utilities Fortnightly*, will make the contest evaluations.

Trophies and certificates will be awarded at the AGA's convention in Atlantic City in October.

AGA promotes several PAR staff members

S. F. Wikstrom has been named director of the American Gas Association's PAR plan. He has been director of promotion and advertising for the association since 1955. As director of the gas industry's $6-million-a-year PAR plan, Mr. Wikstrom succeeds Allen D. Schrodt, who has resigned.

Other PAR staff promotions include elevating Norval D. Jennings to succeed Mr. Wikstrom. Charles R. Bowen succeeds Mr. Jennings as advertising manager. In turn, Kenneth F. Muldoon, manager of the AGA's New Freedom Gas Home Bureau takes over as promotion manager from Mr. Bowen. Mr. Muldoon is succeeded by Gerald P. Mullins, formerly assistant to the director of promotion and advertising.

Advertising manager named by Canadians

Douglas E. Dingwall has been appointed advertising manager of the Canadian Gas Association. He will coordinate the association's new PAM national advertising program which is aimed at promoting the sale of gas and gas-burning appliances and equipment. CGA plans to spend $150,000 for the first year of the program.

Mr. Dingwall also will be responsible for other promotional activities carried out by the Canadian association.

CNGA names new officers

California Natural Gasoline Association elected new officers recently. President is H. J. Maxwell, assistant general manager, producing department, Standard Oil Co. of California Western Operations Inc. K. C. Vaughan, manager of the natural gas and gasoline department of Union Oil Co. of California is vice president. Among directors is P. E. Beckman, vice president in charge of gas operations at Pacific Gas & Electric Co., San Francisco.

Chilton
PUBLICATIONS

Foremost IN THE FIELDS THEY SERVE

CALL A CHILTON MAN

CHILTON COMPANY
56th & Chestnut Streets
Philadelphia 39, Pa.
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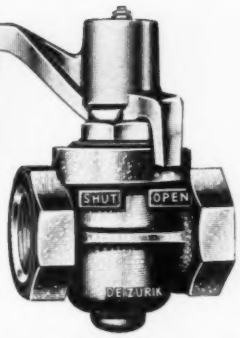
GREAT GAS HANDLERS!



You get trouble-free service on gas lines with DeZurik Valves . . .
Tight Shut-off . . .
No Maintenance . . .
Longer Life . . .
Low Cost!

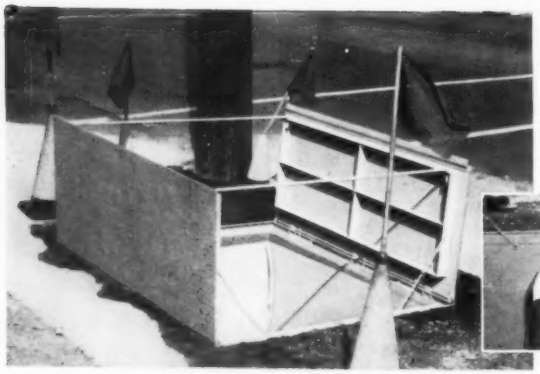
DeZurik Valves provide more advantages than ordinary valves on gas lines because no other valve has DeZurik's *exclusive* eccentric principle!

The plug is pivoted eccentrically in the valve body, touching the seat *only* when the valve is closed. There's no drag, no friction—just *easy* quarter-turn operation . . . without lubrication! The resilient plug-facing insures tight shut-off every time!

More plants are turning to DeZurik Valves every day. Why not try them on *your* gas lines?

Ask the DeZurik representative in your area for recommendations or write to

DeZURIK CORPORATION
SARTELL, MINNESOTA.



For Trouble-Free Off-the-Road Regulator Installations

Bilco Sidewalk Doors provide a safe, easy-opening, watertight protective cover!

Because of the rising cost of street vault construction and increasing traffic hazards, gas companies in many cities are now placing their district regulator equipment in "under-the-sidewalk" locations. They're installing Bilco Sidewalk Doors – for the improved ventilation, built-in drainage features, ease of maintenance, durability and all-around safety you'll get when *you* specify Bilco!

Send coupon today for free copy of reprint from Gas Magazine, entitled: "Standardization and Prefabrication of District Regulator Installations"

Bilco®
DOORS FOR SPECIAL SERVICES

The Bilco Co., Dept. 442, New Haven 5, Conn.
Send folder on "Installations" ☐ Send complete Bilco catalog ☐
NAME .....
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ADDRESS .....
CITY ..... STATE .....

for **leakproof, pressure-tight connections**

use **TiteSeal®**

SEALING COMPOUNDS

Heat and vibration-proof, non-solvent, will not shrink, crack or crumble. Makes all assemblies leak-proof and pressure-tight. Prevents rust, corrosion, joint seizure.

7 BASIC BLENDS

LIQUID WRENCH®
The super-penetrating rust solvent

LOOSENS
rusted bolts, nuts, screws, 'frozen' parts

Liquid Wrench works *fast*... yet is absolutely safe for all metals and alloys.

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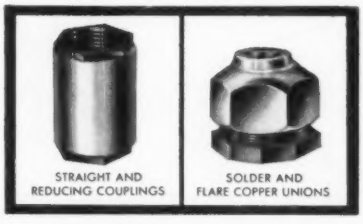
At Industrial, Automotive, Hardware, Plumbing Jobbers

RADIATOR SPECIALTY CO.
Charlotte, North Carolina

SOLDER SEAL



Copper and Iron Pipe joined safely with

MAYCO

dielectric fittings

Copper and iron, brass and iron or other dissimilar metals are safely connected *with no electrolysis* when you use MAYCO dielectric couplings and unions. The cost is low enough to use them on every job—the tough nylon bushing insulates completely . . . withstands temperatures up to 230° F. and pressures up to 1000 lbs. *Order now.*

MAY PRODUCTS, INC.
BOX 427 GALESBURG, ILLINOIS
manufacturers of: MAYCO water softeners & filters . . . MAYCO dielectric fittings

CORROSION PREVENTION

Continued from page 21

not less than three straps, each a minimum of 4 in. wide, of metal equal in weight to the pipe wall. Each strap was primed and coated with pipe line enamel, as was a 12-in. strip down the top of the pipe.

Each separate joint—there were six or seven in each bed—was equipped with its own riser of 4-in. pipe for connections. Surrounding each of these risers, a concentric piece of 6-in. pipe was also welded to the anode; the outer surface of this was wrapped with polyethylene tape, double lapped; and the annular space between the two was filled with asphalt.

The illustration shows a simpler type of riser which is often used, being simply a single piece of pipe, well coated, rising to a point above ground level. The anode cable is then attached, either by bolting or brazing. It can be seen that the principal weapon against early segregation is multiplicity; the next most important measure is watchfulness. Records should be kept of rectifier current and voltage, at very frequent intervals—not less frequent than weekly. These should be plotted against time; any segregation of a part of the anode will then show up as a more or less abrupt increase in ground bed resistance, not otherwise explicable.

To locate the break, a surface potential survey should be run along the length of the anode, and for a short distance past each end. Such a survey should be run early in the life of the bed, before there are any breaks. Comparison of subsequent surveys with the original will readily disclose the discontinuity which points to the break—probably at a riser or a pipe joint. Repairs are not too difficult, and a well-constructed bed should last for at least half the theoretical life, on the 20-lb per amp-yr basis. ■

The R. W. STAFFORD CO.
GAS CONSULTANTS—ENGINEERS—CONSTRUCTORS
Natural Gas Conversions
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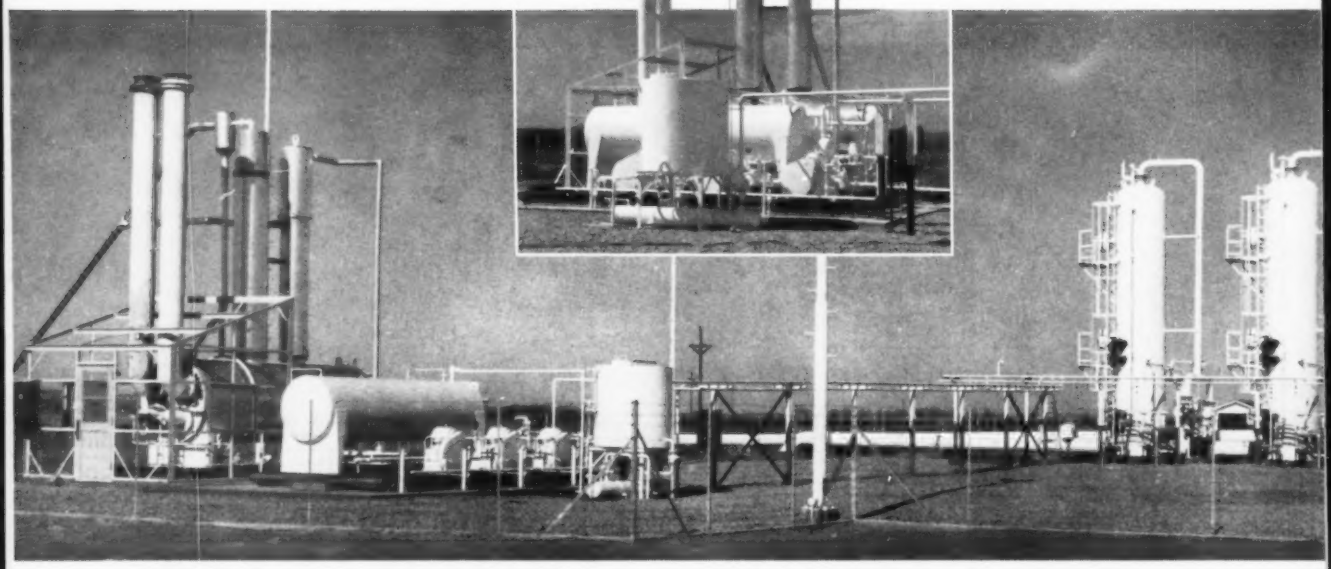
GAS

PIPELINE SECTION

Cold Weather MAINTENANCE

National®

GLYCOL DEHYDRATORS



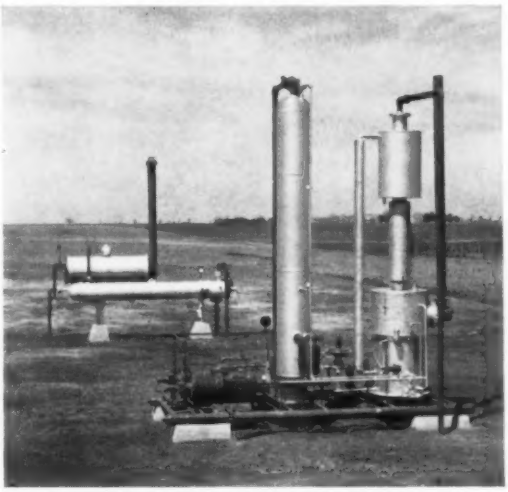
180,000,000 cu. ft./day capacity unit located in the southwestern United States. Installed downstream from a large compressor station.

Automatic Compact Glycol Dehydrators provide for absorption of water from the vapor phase into the dry glycol in the absorber tower. The wet saturated glycol is reconcentrated, followed by recirculation back to the absorber to begin its job all over again.

Glycol Dehydration provides the lowest initial installation cost over other systems and will dry gas to pipeline specifications for most operating conditions. Standard units are available in capacities from the small individual well type (2,000,000 cu. ft./day) to the large central installation (200,000,000 cu. ft./day). Alternate features include winterizing for extreme cold weather operation, housing, integral inlet scrubbers and electric driven pumps.

Designed and engineered to afford "packaging" of greatest per cent of the complete unit.

National can handle all of your gas-production problems — "from the wellhead to the consumer!" Contact your National Representative in your area.



One well unit with indirect heater and inlet MONOTUBE® separator.

WRITE FOR BULLETIN 504-A ON GLYCOL DEHYDRATORS.

It's a National®

NATIONAL TANK COMPANY

TULSA, OKLAHOMA

PART THREE OF A THREE-PART SERIES

GAS exclusive

PARKAS . . . They're "tools" in northern maintenance. Here, maintenance man runs routine check near initiating point on Westcoast's 650-mile line.

Westcoast Transmission does a lot of . . .

Cold weather maintenance

By JAMES JOSEPH

FORT ST. JOHN, BRITISH COLUMBIA . . . along the ice-sheathed Alaska Highway, 650 miles north of Vancouver, a pipeline maintenance man hunches in the cab of his pickup truck, microphone in hand. It is 9 am, yet black as midnight. Not for another hour will the January sun edge the British Columbian horizon.

"Valve #5 checks OK," he reports by VHF radio to his maintenance chief at Taylor, the bustling new $19 million industrial complex which has grown up near Westcoast Transmission Co. Ltd's Compressor Station #1—along Canada's 650-mile, 30-in. "Big Inch."

"Read you," comes quick confirmation, "guess you'd better head in now—you've got an hour's drive."

Suddenly a voice cuts into the maintenance channel. "Message relay from health center supervisor, Vancouver . . . message for J. R. Hawkins and family at Milepost 101, the Alaska Highway . . ."

There's a pause, then . . . "condition your daughter serious. Urgent you reach her bedside immediately."

The pipeliner winces . . . and pulls his parka closer. In the Canadian North a gas company's radio channel is as likely to blurt maintenance data as messages of mercy.

Such are the dynamics—and drama—of pipeline and compressor maintenance in northwestern Canada.

Yet Westcoast's Division I maintenance super, Kansas-born R. M. Hawkins says stoutly, "maintenance problems? We haven't any—far as I'm concerned."

Echoing him is another of Westcoast's old-hands, R. C. Appling, who's superintendent of operations.

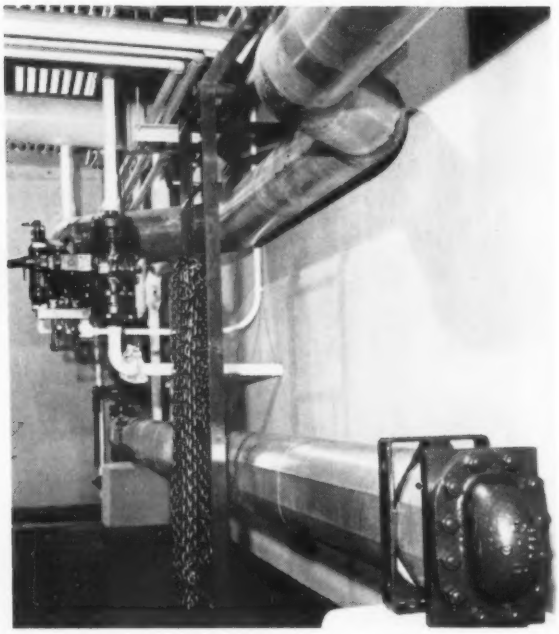
"We've had nothing you'd call real trouble," he confirms, "and mostly I'd credit it to the fact that more than 90 per cent of this line was hydrostatically tested . . . and to 90 per cent of minimum yield strength, to 1117 lb."

Hydrostatic testing is but one maintenance-construction highlight along Canada's "Big Inch," which became operative only in October 1957. Among others:

(1) *A divisional breakdown* which sees heavy and light pipeline crews and equipment strategically sited along the 650-mile right-of-way, much of it through virgin—and winter-cold—wilderness.

(2) *Line pigging*—a daily chore along Westcoast's major gathering lines where distillates run to 700 bbl per 50 MMcf of gas.

(3) *Cold weather concrete pour*—among the neatest tricks in compressor plant construction.



JACKETED PIPING . . . Although these hot water (180 degree) lines run within the warm basement of Station No. 1, they're nonetheless jacketed—as cold-weather protection. One reason for jacketing: pipes run close to exterior walls and are vulnerable even though they're indoors.

(4) *"Routine" pipe repair*—which, with temperatures down to minus 30-40, the muskeged-ground frozen to a depth of 3 ft, isn't "routine" at all.

Routine or not, repair crews with any mileage ahead of them seldom venture out without survival gear (sleeping bags, parkas and fire-starters). Nor do they ignore the North Country's Rule No. 1: "if your truck bogs down, build a fire first—*then* cure the trouble, if you can."

An Alberta oil-field worker who this winter forgot the rule (he straightaway began tinkering with his stalled truck) was found frozen to death, a dozen matches still clutched in his stiff hands.

• Hydrostatic test

Westcoast's maintenance crews initiated the hydrostatic line test, although the contractor, Canadian Bechtel Ltd., took it from there.

The job was complicated because (1) much of the country is mountainous; (2) with gas temperatures predicted to go as low as 24 degrees, the dewpoint to 17-18 degrees, it was essential to dry out the pipe once tested—else invite hydration; (3) specs called for no more than 7-lb moisture per Mcf (though Westcoast's double-barrelled cleaning process wrung the line so dry that moisture content seldom registers more than 5-6 lb).

In drying the line, Westcoast crewmen first ran a pig to displace the bulk of test water. Behind the pig were run three specially designed Maloney scraper cups. Cups an inch larger than the pipe's ID, were line-inserted compressed. Acting like squeegees (and inserted from launching tubes installed valve-to-valve), the scrapers pushed out most of the remaining moisture. Still not satisfied, crews dumped prodigious quantities of methanol in behind the cups—some 200 Imperial gal. per mile, more than 108,000 gal. in all.

Clean-up crews—working both from the north and south—got the job done in a record 45 days.

Explains Appling, "after the hydrostatic was completed and most of the water pushed out, we began cleaning, valve-to-valve. We'd set a valve out and put in a launcher, set a receiving tube ahead of us at the next valve—and run the special cups and methanol behind them."

To pressure pigs, Westcoast purchased gas from Pacific Northwest Pipeline Corp.

• Divisional breakdown

Westcoast's maintenance complex is segmented into two phases:

(1) *Compressor station maintenance*—bossed by compressor plant super Bill Hall, each of the Big Inch's four stations looks after its own internal housekeeping—and its own engines.

Typically, Station No. 1's 18 staffers include three utility men—really maintainers, plus a plant electrician.

(2) *Line maintenance*—comprises a sprawling network linked by microwave and VHF radio, keyed to strategic caches of spares and mobile equipment. Line crews operate over the system's 650 miles of right-of-way (60 ft wide) and along 156 miles of gathering line (45 miles of it 26-in. diameter).

Three divisions patrol the mainline: (a) Division I covering 105 line miles (downstream from Taylor, B. C.), plus the gathering system; (b) Division II—from Milepost 105 to the Quesnel river crossing, a distance of 307 line miles; (c) Division III—from the Quesnel to Huntingdon, B. C., where Westcoast meters

Radio links compressor stations and maintenance crews along Westcoast's line. Here, via microwave, Plant No. 1 operational boss, Melvin Shannon, talks to headquarters in Vancouver.

to contract distributors, a maintenance beat some 235 miles long.

Strategically massed along the right-of-way are maintenance platoons, some heavy (equipped with sidebooms, heavy trucks, dozers and Westcoast's specially designed lowboys—pipe-toting 10-ton, 18-ft long dieselized rigs); and light crews (as few as four men and their equipment).

Typical of winter maintenance was repair of a pinhole break in a 26-in. gathering line's seam near Westcoast's Alberta check-meter station. Discovered by a "walking" patrol (the leak spotted because the newly frozen muskeg was "bubbling"), a VHF call went out to division headquarters (at Taylor). Almost as fast, a light crew was on its way—via radio-equipped pickups. Fastest route—by provincial roads—wound through 100 miles of backcountry.

Within seven hours crewmen had (1) dug the line out; (2) shut off the pressure; (3) patched the leak with a neoprene "plug" (the neoprene sandwiched between the seam and an 8-in. long patch of 26-in. line, the whole thing butt-welded in place).

Concedes one maintenance man, "we were lucky on that one. The ground hadn't really frozen. It'd have been a tougher story—with the muskegs frozen to 36 in."

Steam thawers can get down below the frost line—if the machines are at hand. Even so, the going's slow. Another method, where gas conditions permit, is simply to pile sawdust and coal above the break area, pour on fuel oil and kindle a fire.

Almost as tedious is repair of aboveground piping. To warm a scant 12-in. pipe section (to welding temperatures), maintenance men rig a propane-burning machine over the break. The burner, with 12 gas jets, can pre-heat pipe up to 24 in. in diameter. As the steel comes up to welding heat (200-300 degrees F), a temperature template-stick tests for warmth (stick melts at proper weld temperature). Two welders immediately get to work, don't put down their rods until the job's done.

"If they did," says a maintainer, "they'd have to pre-heat all over again."

• Cold-weather concrete pour

Neatest trick in construction came during September 1956 when, with temperatures skidding to —15 degrees, Compressor Station No. 1's engine foundation blocks (21x10x9.2 ft) were poured. Each weighed 200 tons, required 125 yd of concrete.

Rigged around each block-form was a tarp canopy, framed with 2x4s. Inside were placed four salamanders (oil-fueled heaters), calculated to maintain 60 degrees for the 72-hr curing period.

Aggregate was pre-heated . . . by installing 12 sets of 1-in. diameter coils beneath sand and aggregate piles, the coils supplied steam from a diesel-oil fueled boiler.

Even the concrete was hot-batched . . . through use of 65-degree hot water.

Nor was concrete poured unless it tested 50 degrees —and preferably higher. Poured, concrete was constantly monitored by thermometers (some inserted in the mix, some hung inside the heated canopies).

Pigging the line, wearing mask (against sour gas), maintenance man pigs a gathering line in Westcoast's system.

When, five days after the pour, forms were pulled, the concrete was still warm—yet outside ambient temperatures varied between —3 and —15 degrees.

With distillates in some "sour" gas gathering lines running as high as 700 bbl per 50 MMcf, two lines (15.7 miles of 20-in. from Buick Creek, 38.1 miles of 26-in. line gathering from the same area) must be pigged every 24 hours.

Abuilding now at the Taylor, B. C., industrial by-products complex (terminus of the gathering system) are surge tanks to take the distillates. Meantime, the plant uses what it can, burns what it can't.

Three men (gas-masked against the high H_2S concentration) comprise the pigging crew. Pigs are pressured into the system via overhead sending barrels (receiving barrels are likewise above-ground). Required are some 20-30 psig above usual line pressure —which is about 450 psig.

This additional pressure is built-up through a 20-in. by-pass (typical is one on the 26-in. gathering line). With sufficient pressure, the pig begins its travel, pushing sludge ahead of it.

Normally, gathering line pigs travel about 3 mph, require fully 12 hours to cover 38 miles.

At Taylor-area receiving barrels, pigs are recovered —and trucked back to the sending site in an open pick-up (necessary because the cups are contaminated by H_2S fumes).

Pigging's not currently required for other sour gas lines, since pressure's high enough to rid them of sludge.

In the Canadian north, weather affects men as well as materials.

Growing careless, a maintenance man picked up a sizzling-cold wrench in his bare hands. He dropped it almost as quickly—but in that second of forgetfulness, lost a palm-full of flesh.

Wincing as a first-aider applied gauze and bandage, he muttered, "up here a guy's tools kinda stick to him."

And at minus 40 degrees, they do. ■

PG&E designs unique pipeline-break control and alarm system

WITHIN a very few years after the completion of the PG&E "Super Inch," the major supply of gas for northern California was being delivered through this 34-in. pipeline. Now, some 70 per cent of all of the gas supplied by PG&E and almost all of the gas required for the populous San Francisco Peninsula comes from this 500-mile artery.

As northern California became more and more dependent upon out-of-state gas, the security of the ippeline became paramount in importance. Special construction equipment capable of traveling at high speeds was purchased and located at strategic points along with stockpiles of emergency material. Emergency procedures were established and additional mobile radio coverage was provided. These measures were designed to materially reduce downtime of the pipeline in the event of a serious break.

However, there still remained the problem of detecting, locating, and isolating a break. The pipeline was already equipped with pressure telemetering at approximately 50-mile intervals. Given time, these telemeters would indicate a break. By the time telemeter readings changed appreciably, thereby indicating a break, large volumes of gas would have been lost. And there was the problem of locating the actual break and then isolating that section of the line.

The pipeline crosses desolate country. Portions of the line are easily 75-highway miles from the nearest maintenance station. Many hours could be spent wandering aimlessly through the desert looking for the sound or sign of a line break. In the interim, the inventory of gas contained in 150 miles or more of 34-in. pipeline could easily disappear into the atmosphere.

Such gas loss would seriously jeopardize the continuity of service to the Bay Area and much of northern California. It would take many hours before the pipeline could deliver gas again. Much of the firm load in the affected area could be supported from the local fields, but again there is the question of time. A major re-routing and increase of local gas sendout takes many hours—even if the move has been scheduled.

A decision was made to equip a number of strategically located valves and pressure limiting stations along the pipeline with automatic equipment that would sense a major break, initiate valve closures to isolate the ruptured section, and report the location of the trouble to the nearest attended station. Automatic equipment to sense a line break was not new to the industry, but the problems posed by the alarm features of the proposed system were unique.

There are two methods currently used to sense a line rupture (*Figs. 1a and 1b*). One method measures the rate of pressure change by using a capacity tank and a small restricting orifice. A line rupture causes a rapid drop of pressure in the pipeline, and a differential sensing device between the pipeline and the capacity tank detects this change and initiates a valve closure. The other method utilizes the line valve as a differential metering device, and a differential sensing device or devices will detect either an abnormal or reverse flow and in turn initiate a valve closure.

It was decided that the second method would be used, primarily because there was concern that the rate-of-pressure-change method might close more than the necessary valves in the system. There was also a feeling that the restricting orifice in the rate-of-pressure-change system would become blocked and normal variation in line pressures might cause an inadvertent valve closure.

Most of the applicable differential sensing devices on the market are pneumatic controllers—either a pneumatic transmitter or self-contained controller. Such a device requires a continuous supply of 20 psig gas or air. Developing instrument gas supply can be very costly, and gas is continuously bled to the atmosphere. It was decided that a differential sensing device

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Pacific Gas & Electric Co., San Francisco
and
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Sierra Electronic Corp., Menlo Park, Calif.

that merely opens a valve would be more desirable, if such a device could be obtained.

The Reliance Regulator division of American Meter Co. produces a differential trip valve. After consulting their engineers, it was determined that certain modifications could be made which would make use of this device feasible. Reliance began production of the differential control valve, Type X-196-4 (*Fig. 2*). After some minor difficulties were eliminated, the trip valve proved to be entirely satisfactory.

The selected line valves were equipped with a gear reducer and a pneumatic motor assembly. PG&E had previously installed such units on automatic valves in pressure limiting stations on the Super Inch. The gear reducers (Rockwell-Nordstrom) were built by Rockwell Manufacturing Co. and the pneumatic motors were made by the Hydraulic Co. and furnished by the Clayton Valve Co., Newport Beach, Calif.

A simple control system was evolved to actuate the various line valves. This equipment was pipe mounted and housed in a demountable transite shelter to protect the equipment from the desert climate (*Fig. 3*). Modifications were made to existing controls at pressure limiting stations to permit trip valves to override normal operation of automatic pressure limiting equipment. At both line rupture valves and pressure limiting stations, a pressure switch was provided between the trip valve and pneumatic motor to initiate the alarm function (*Fig. 4*).

Problems presented by the alarm system were numerous and difficult. When the Super Inch was built, a single open-pair telephone circuit was installed

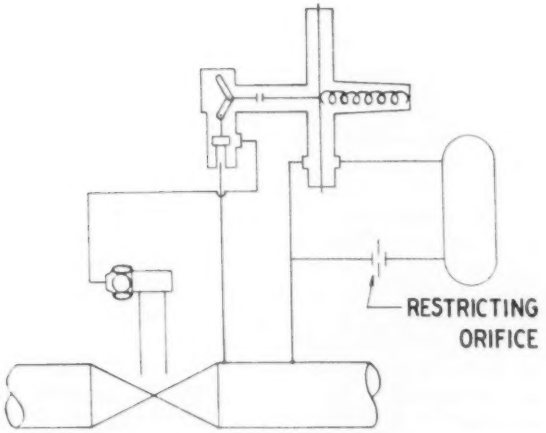


Fig. 1a. Control system for sensing line break with rate of pressure change.

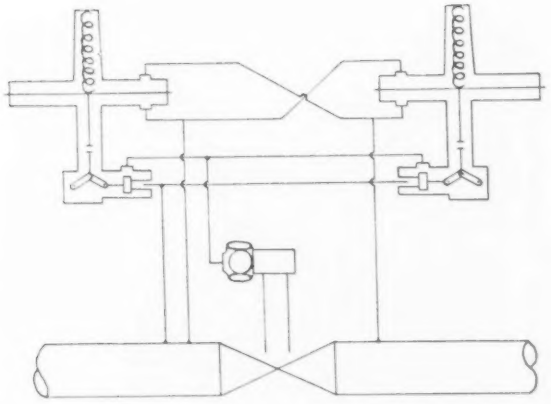


Fig. 1b. Control system senses pipeline break through abnormal or reverse flow using differential across line valve.

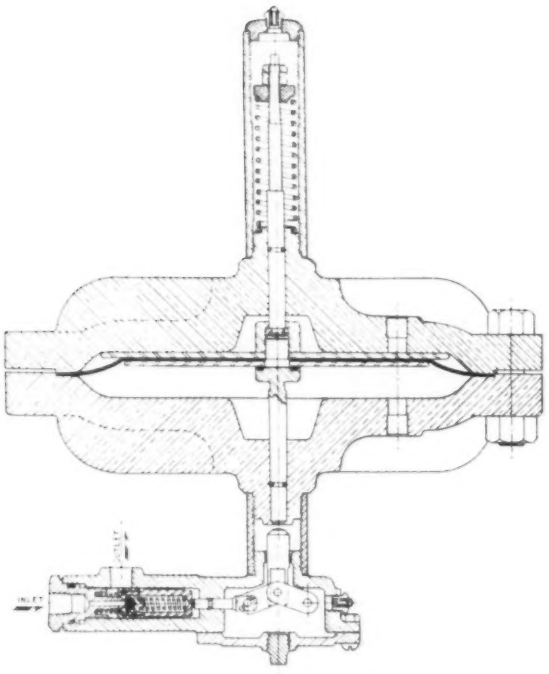
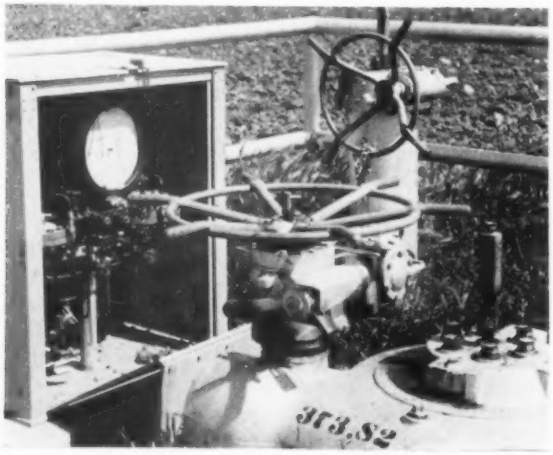


Fig. 2. Differential control valve used in PG&E's line-break sensing system.

parallel to the pipeline—in most places within the right-of-way. With the exception of commercial toll-telephone service and mobile radio, this was the only communication facility for the pipeline's operation. Maintenance personnel use the physical circuit; and telemetering, teletype, and through telephone are derived from carrier frequency channels.

Super Inch starts at the California-Arizona border near Topock, Ariz.; crosses the Mojave desert; goes over the Tehachapi mountains; and passes through the fertile farm lands of the San Joaquin and Santa Clara valleys. Throughout its route the pipeline is subjected to some of the most violent weather in California—lightning, sandstorms, cloudbursts, and temperature extremes of 0 to 140 degrees F. There are very few places along the line that are even close to electric power lines. And at most of these places the power is not dependable.

Fig. 3. Field installation of the control system at a mainline block valve.



At the time PG&E was starting its line-rupture control program, a survey of available equipment was made. It was found that there were no suitable alarm systems on the market. Therefore, Sierra Electronic Corp., Menlo Park, Calif., was asked to make necessary studies and develop a plan in sufficient detail to permit cost evaluation of an alarm system.

Quite a bit of thought was given to various ways of using the physical circuit. The operation of the line rupture alarm is of such importance that it could take priority over all other traffic on the telephone line for the short time required to transmit the coded information. However, during the hot summer months in the desert, dust and lightning storms, which occur quite often, can charge the line. When the static charge rises to about 200 v, protective spark gaps flash over and discharge the line. This results in low-frequency saw-tooth waves with harmonics up to 3 or 4 kc. Under such conditions the physical circuit is all but useless. PG&E knew that carrier frequency channels experience little interference during these storms. Therefore, carrier signaling was chosen in preference to use of the physical circuit.

The simplest method for signaling would be a standard carrier-frequency telemetering transmitter operated by the valve closure. Each alarmed location would be assigned a different frequency. Since this would require approximately 20 telemetric channels, it would occupy too much of the valuable frequency spectrum on an already-crowded telephone line. To conserve spectrum, some coding method was necessary.

Two general methods are used to code alarm devices. In one, the open-end system, the remote alarm unit transmits a coded identification signal which terminal equipment records. In the other, a transponder system, terminal equipment interrogates various alarms and only those units in an alarm condition respond.

The alarm system, at this stage of planning, was a coded signal transmitted on a minimum number of carrier frequency telemetering channels with two coding systems from which to choose. The open-end system, which is by nature the simplest, has two serious disadvantages: if two valves are activated about the same time, their signals might interefere and give a false indication; or, if the pipeline ruptures, the telephone line might be damaged by flying debris, thereby causing signal interference.

The transponder system is made free from mutual interference by giving the operator at the terminal the opportunity to re-check his data in the event of simultaneous operation of remote equipment. However, it has the disadvantage of being more complex.

Interlocked with the choice of the general system is the method of coding the information. There are

The problem: detecting, locating, and isolating a line break

several coding methods which are applicable to this particular problem: Sub-carrier modulation, carrier amplitude, and pulse coding (*Fig. 5*). Sub-carrier modulation is frequently used in commercially-available supervisory-control systems. However, it has the disadvantage of requiring as much frequency spectrum as individual, carrier-frequency telemetering sets. In addition, the equipment required for sub-carrier modulation is very complex and costly.

Carrier amplitude is a very simple coding method. However, it would require almost continuous maintenance to assure the proper levels of various alarm units. To further complicate the use of carrier amplitude coding, the telephone line attenuation, or loss characteristics, varies with the weather.

There are three types of pulse coding in common use. The pulse number system is probably the most common, as it is used in the dial telephone. The number of pulses in a train indicates the function. The pulse number method is best suited for an open-end system.

The pulse length method is in general use in the gas industry (time impulse telemetering is a form of pulse length coding). The duration of the pulse gives the coded information.

The pulse position method may be used in two ways. The time between two pulses may indicate the code. Or, the number of pulses transmitted by terminal equipment between two pulses may also determine the code. The transponder system lends itself best to pulse position coding.

Sierra Electronics proposed five different systems that could be developed to perform the specified functions. A conference was held with the gas and communication department engineers. It was decided that a two-tone transponder system would provide greater reliability. Sierra then prepared details and specifications as requested.

The system consists of remote alarm units located at the line rupture valves, and terminal alarm equipment located at the various attended stations. The remote alarm unit is comprised of transistorized carrier-frequency transmitter and receiver, associated relays, power supply, and manual test switches. Relays, transmitter, and receiver are assembled in a cast aluminum weatherproof enclosure that is designed for pole-top mounting (*Fig. 6*). Power supply, test and reset switches are assembled in a sheet aluminum box that can be mounted lower on the pole for easy accessibility. In addition to these switches, the test and battery box contains terminals for a portable telephone and a line bridging switch which connects the telephone terminals to the phone line.

The remote alarm unit is connected to the test and battery box with multi-conductor outdoor service cable. This cable has a weatherproof Cannon plug adjacent to the remote alarm unit. The unit may be easily removed for maintenance or repair by loosening two

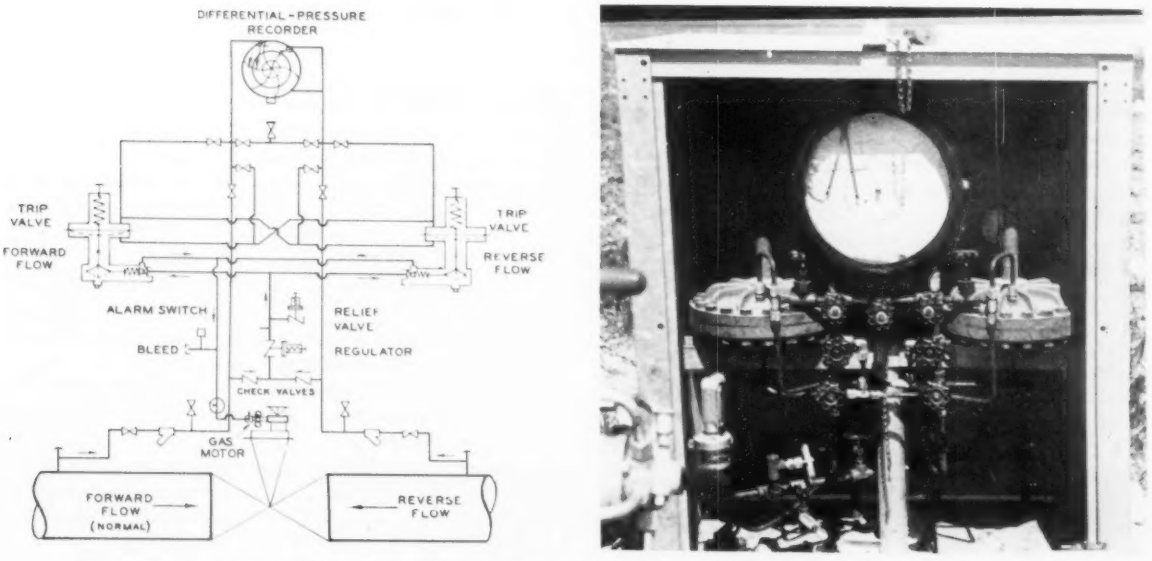


Fig. 4. Schematic drawing (A at left) and interior close-up (B, right) show detail of line rupture monitoring installation on PG&E's Super Inch.

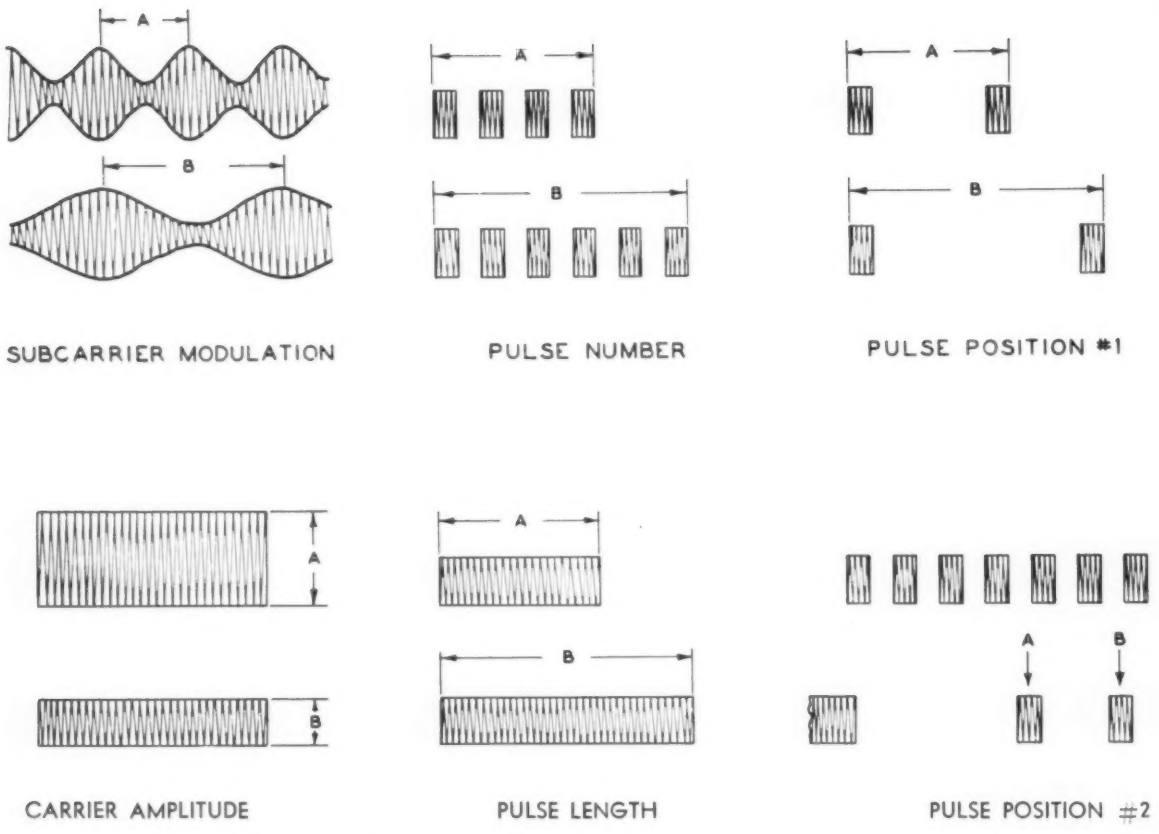


Fig. 5. Possibilities for coding telemetric intelligence.

screws and disconnecting the Cannon plug.

The carrier transmitter and receiver of the remote alarm unit are mounted on individual printed-circuit boards which plug into the main chassis. Transistor circuitry was employed for two reasons: first, low power drain; second, reliability. Due to modern production control and packaging techniques, transistor life now apparently exceeds that for other components in an electronic circuit. Transistors will change with the temperature, but expansion joints or bends can be designed to compensate for changes in their characteristics.

The terminal alarm equipment consists of two Lynch B-5 carrier-frequency receivers and one transmitter, and relay and display panels. The relay panel (*Fig. 7*) contains a selector switch, control relays, and holding relays. The display panel includes indicator lights, alarm re-set switch, and test switches (*Fig. 8*). A terminal alarm unit is located at each end of the line under surveillance.

In the event of a line rupture, a high or reverse differential will be produced across the mainline block valve. This abnormal differential will operate the differential trip valve. The differential trip valve actuates the alarm switch and pneumatically-operated mainline valve.

When the alarm switch is closed, the line-bridging relay will connect the remote alarm unit to the telephone line. (*See Fig. 9.*) At the same time the carrier transmitter and receiver of the remote alarm unit will be energized. The transmitter will initiate a 7.9-kc tone. The 7.9-kc receivers in both the master and slave stations will receive this signal and sound an alarm at both stations. Then, the master station will interrogate the line by transmitting a train of pulses at 7.3-kc. The stepping switches in the master unit, slave unit and remote unit will step-up together. When the stepping switch in the remote alarm unit reaches a point corresponding to its particular code, the 7.9-kc transmitter in that unit, which was silenced by the first pulse of the interrogation chain, will be re-energized to mark valve identification. Interrogation will continue through the remaining points and any other remote alarm units that are energized will also respond at their corresponding codes.

If, after a predetermined time from initial alarm, the master station has not begun its interrogation, the slave station will interrogate the line. In this case, the master will become the slave if its circuitry is still functional. The remote alarm units that have been energized will remain connected to the telephone line for later re-interrogation until they have been manually reset.

In operation, the sounding of the alarm will warn

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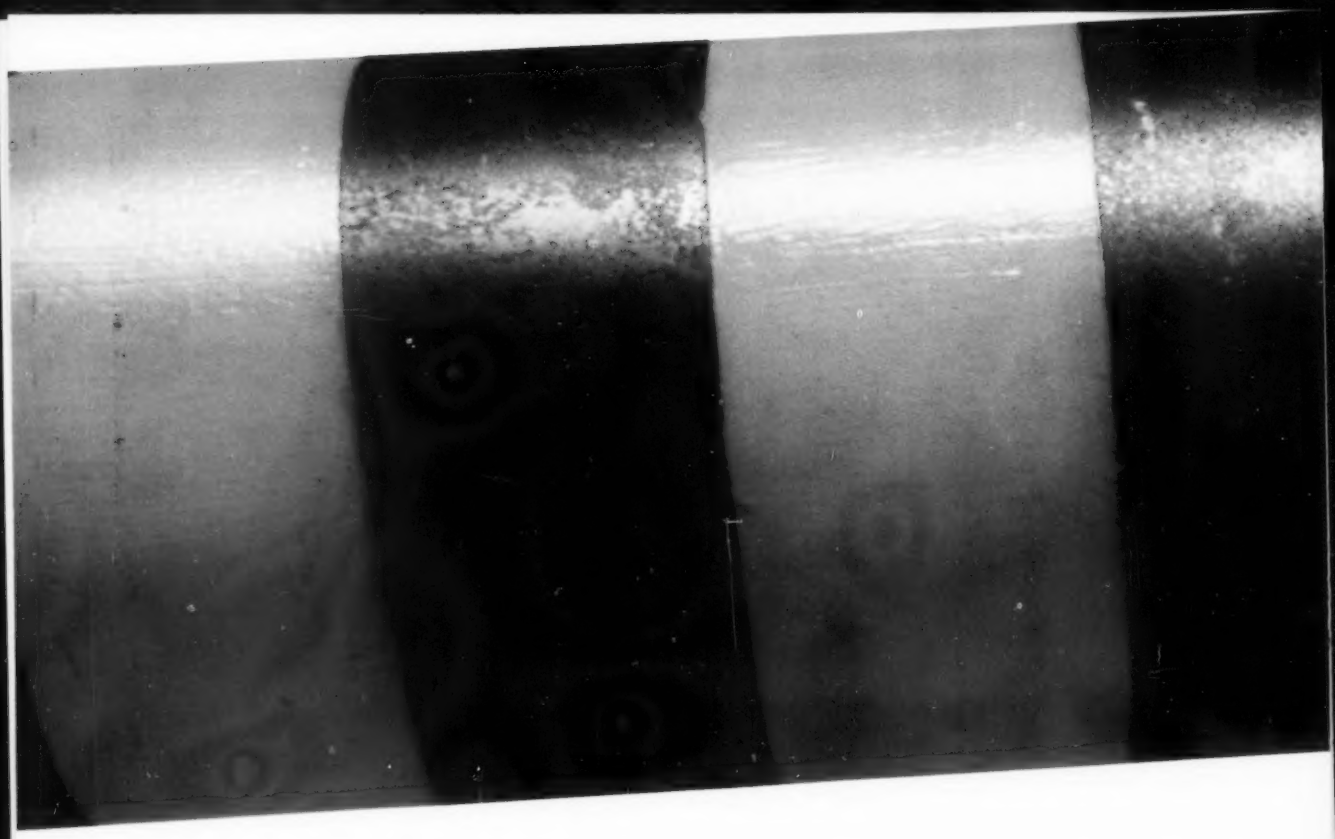

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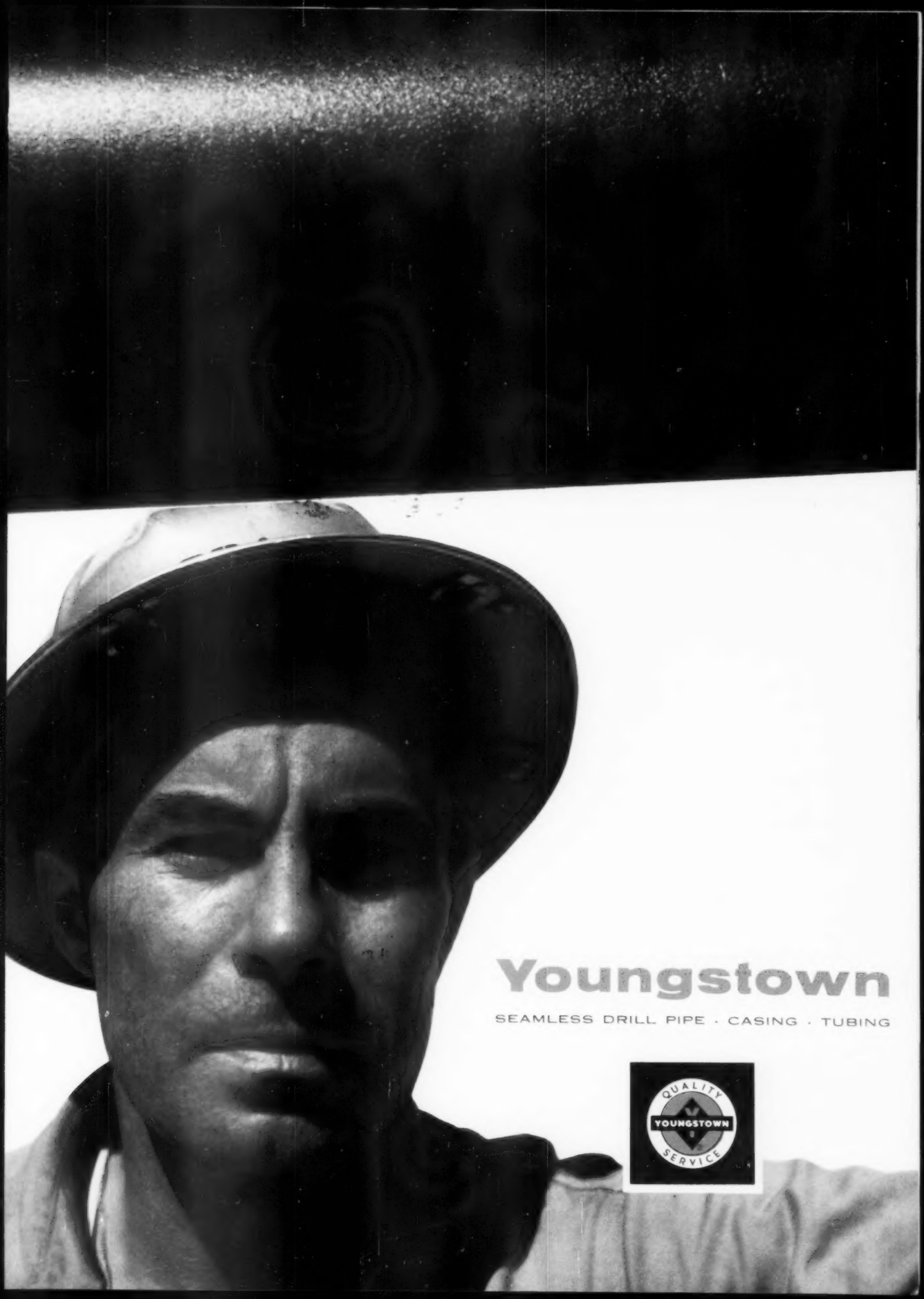
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Along the new highways . . .
ROSKOTE DOES THE JOB WITH SPEED!

Fast drying that permits overcoating or wrapping in a half hour steps up the protective coating phase of new pipeline construction on the jobs where speed is essential — along the nation's new network of highways.

A good example is this 8000 foot stretch of new 8" pipe along the new Southside Expressway in downtown Charleston, W. Va. It was installed recently for the United Fuel Gas Company by Saul and McCallister, Inc., of Yawkey, W. Va.

This contractor found that two men, using the Roskoter for application of Roskote 612 XM cold-applied pipe mastic, could keep pace nicely with the welders. The coating specifications called for over-the-ditch cleaning, two 15 mil applications of Roskote 30 minutes apart, followed immediately by wrapping with 15 lb. perforated asbestos pipeline felt.

Roskote 612XM is a cold-applied, fast-drying pipe mastic of high electrical resistivity. Composed of high grade native pyrobitumens homogenized with quality aromatic solvents and inhibitive pigments, Roskote is also highly resistant to corrosion by acid, alkali and salt. It dries to a tack-free film in 30 minutes or less. It is unaffected by temperature from sub-zero to 250°F. It will not oxidize, scale or check, and it bonds readily to previous coats of Roskote, coal tar or asphalt.

Non-toxic and non-irritant, Roskote may be applied by brush, glove, spray or Roskoter. The latter is seen in use in the photograph.

The Roskoter, one of the simplest means of coating pipe known, is also the most effective. It actually "bathes" the pipe in mastic as an extra safeguard against pinholes and other coating irregularities. And it gets the undersurface and other hard-to-see spots, often missed. Coating with the Roskoter can usually be handled by one man.

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A LEADER IN THE FIELD OF INDUSTRIAL COATINGS FOR CORROSION CONTROL.

the terminal control operator, who will reset the alarm and observe on the display panel which alarm function has been identified. He may then check his display by means of a valve check switch which will cycle the stepping switch and repeat the identification. If noise triggers the alarm, an alarm function indication will not reappear. In addition, a display check switch is available which cycles the holding relays, and their associated identifying display lights, to insure their correct operation.

The use of terminal alarm units at each end of the line under surveillance provides a high degree of reliability, since a failure of one terminal unit, or a break in the communication link to one terminal unit, will not impair the identification of the alarm function. Sufficient signal strength is employed to overcome a partial grounding of the telephone line as might be experienced by a downed line. It is, in addition, safe from operator mismanagement, since the display indication can be cleared only by correcting the cause of an alarm function at its source and re-interrogating the line.

The transponder system is capable of extremely long life, because the remote alarm units are normally not energized. When they are energized by testing or actual valve closure, the transmitter is active only during initial identification and the receiver and line-

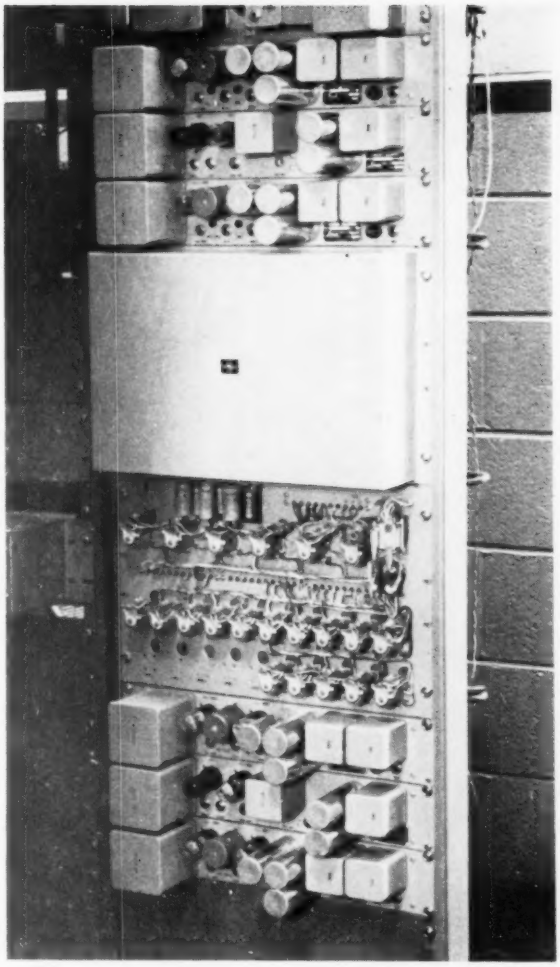


Fig. 7. Selector switch, control relays and holding relays are contained in this relay panel component of terminal alarm equipment.

Fig. 6. Covered (left) and exposed (right) views of a remote alarm unit.

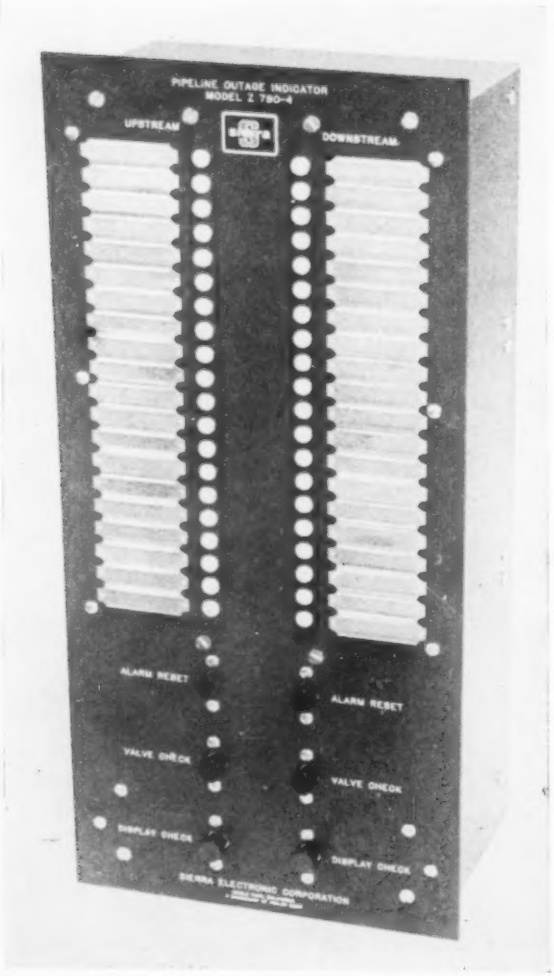


Fig. 8. Pipeline break indicator panel built into terminal equipment.

bridging relay, which remain energized until reset, require a very small battery drain.

The line rupture alarm system incorporates many new and untried features. All individual units and the complete system were thoroughly tested in the laboratory before being delivered to PG&E. These tests included operation of remote alarm units for long periods at elevated temperatures, frequency stability tests and simulated system operation.

As might be expected, a few bugs developed after the system was in operation. However, the most troublesome problem occurred as a result of damage to the equipment in transit. Apparently, the trucker pushed the boxes off the back end of his truck. Almost every relay in all the remote alarm units required adjustment before units could be placed in service. After installation, it was found that an inadvertent grounding of one leg of the telephone line could produce enough noise to cause a false alarm. Also, one of the castings that forms the housing for a remote alarm unit was found to be porous and permitted water to enter the unit. Solutions to these two problems have been developed and corrective measures are being taken.

The line rupture alarm system has only been required to function on periodic test. It is hoped that this will be its only function. However, should the occasion arise, it is anticipated that the alarm system will perform satisfactorily. ■

This article is adapted from a paper presented at the PCGA transmission conference, held in San Diego, Calif., May 6-7, 1958.

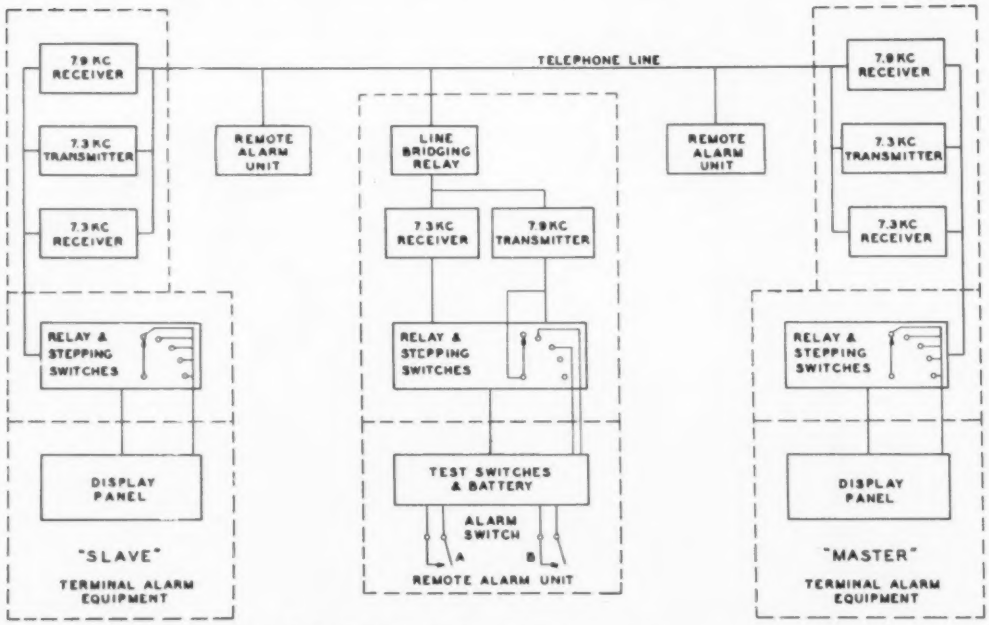
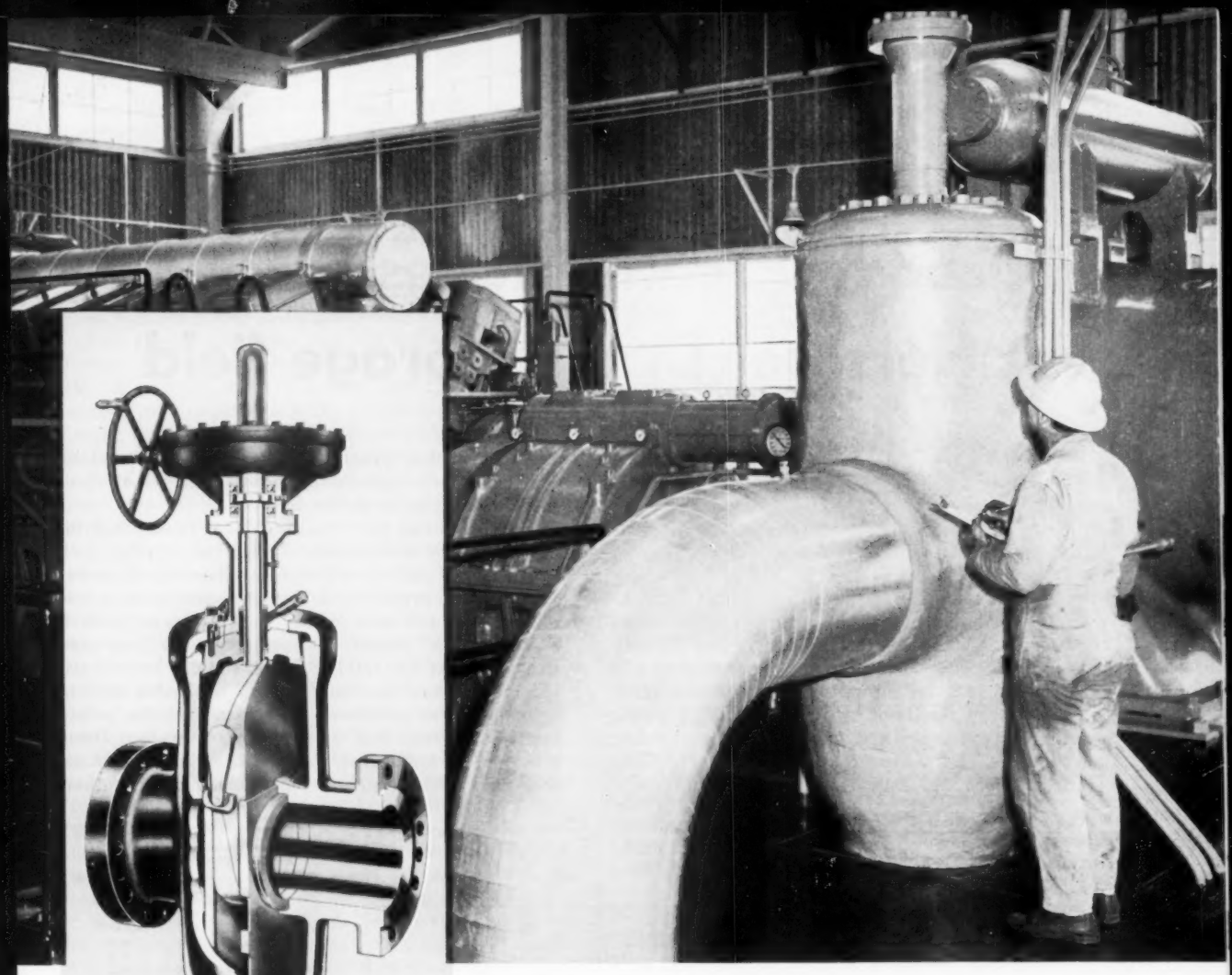
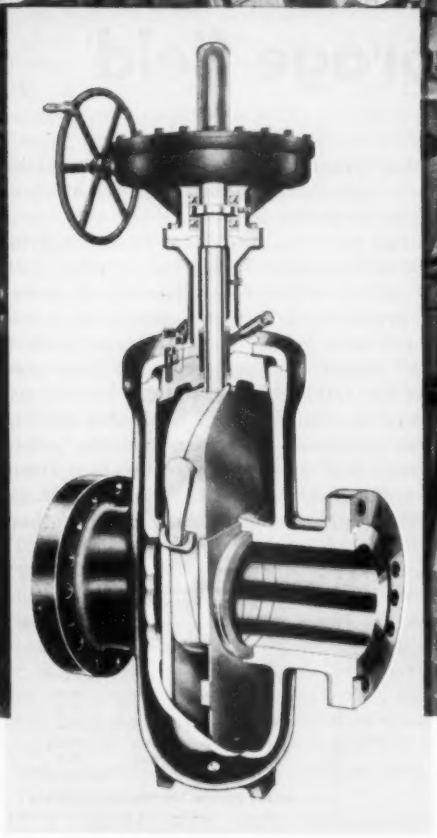


Fig. 9. This block diagram schematically illustrates the line-rupture alarm system.





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New down-hole drilling tool exhibited faster penetration through hard formations in a direct comparison with conventional rotary tools.

Turbodrill really makes hole at Herscher Dome storage field

IT has been hard to make hole when drilling Cambrian- and Ordovician-age clastic and carbonate sedimentary strata at Natural Gas Storage Co. of Illinois' Herscher Dome storage field. Storage wells mean large diameter holes to shallow depths. Drilling them through hard and broken formations with rotary equipment is not easy.

The prime problem is bit-bouncing and resultant vibration. The source of the problem is lack of sufficient weight application to large-diameter drilling bits (17.5 in. and 12.25 in.) in wells drilled to a total depth of 2550 ft. The results of bit-bounce are: dog-legged holes, drill pipe twist offs, low rate of penetration, short bit life, and mechanical damage to the drilling rig from vibration. But, Natural Gas Storage Co. needed a drilling program of 10 or more wells in its big underground gas storage field. These were scheduled for completion before fall.

Moran Drilling Co. (Wichita Falls, Texas), a drilling contractor with plenty of experience in hardrock drilling, took on the new well program for Herscher Dome. It had previously drilled 25 rotary wells in this storage field and knew exactly what it was up against.

R. J. "Dick" Moran, president of the drilling company, thought his drilling venture might be an ideal spot to put new turbine-powered, rotary-bit drilling techniques and equipment to the acid test. So, before starting Natural Gas Storage Co.'s Herscher Dome program, he took a very close look at Dresser Industries' Turbodrill. And he decided to use it at Herscher.

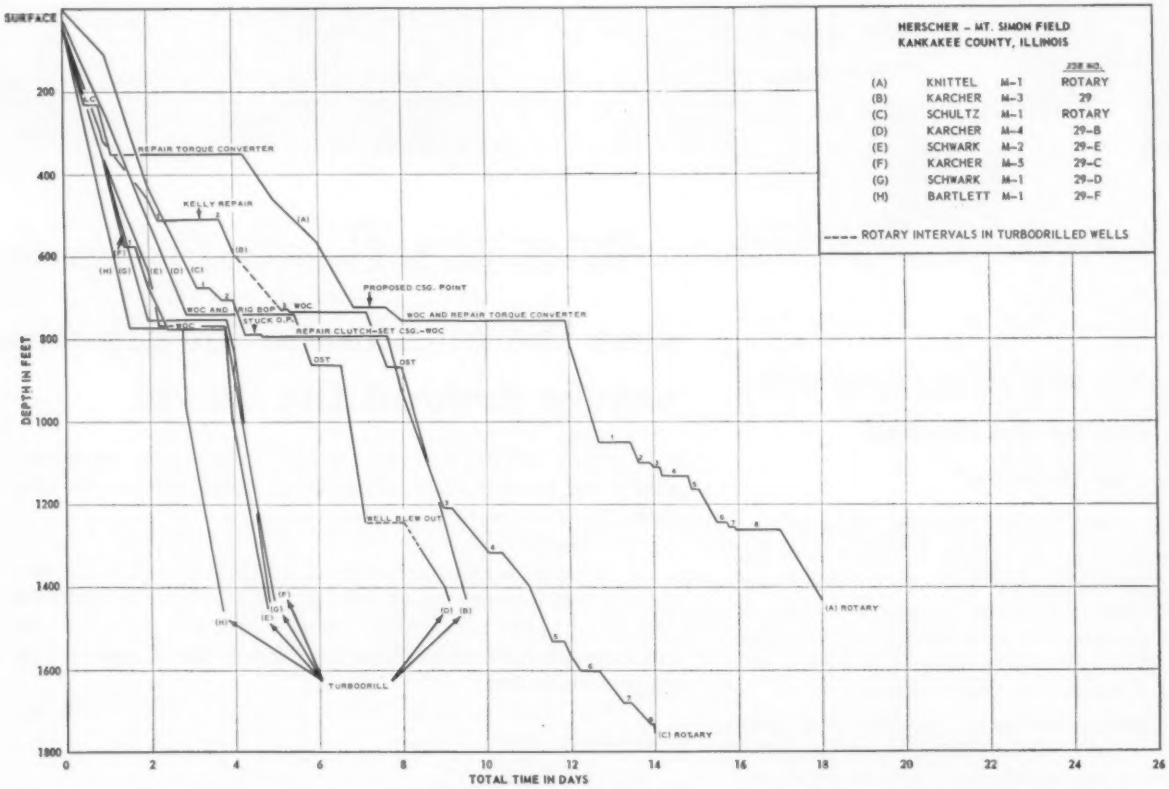


Fig. 1. Direct comparison between conventional rotary and turbodrilled wells at Herscher Dome is shown on this graph of drilling depth vs. time.

The Turbodrill is a down-hole drilling engine. Energy to power the turbine is supplied by circulating drilling mud. Rotary motion from the turbine is transferred to a conventional rock bit. It is not necessary to rotate the drill string when running a Turbodrill; however, in actual practice, the rotary table is usually turned clockwise at the lowest rpm possible or the rotary is simply unlocked to permit counterclockwise rotation from the natural back-up torque. Thus, good hole conditions are maintained.

This revolutionary new tool was brought over from Europe by Dresser Industries. Since then, it has been the subject of much research and speculation. It seemed very logical to both Dresser Industries and Moran Drilling to use the down-hole engine on Natural Gas Storage's program at Herscher because:

1. Turbodrilling is most effective in hard formations, and strata underlying Herscher Dome are in this classification.

2. The storage wells being large diameter and relatively shallow offer very difficult drilling using conventional rotary or cable tool equipment.

3. Moran Drilling planned to use two rigs: Rig No. 11 would be a conventional rotary, while Rig No. 14 would be turbodrilling. Thus, data would give a direct comparison of the two methods in the same formations, using similarly good drilling crews, and by generally matching the methods as closely as possible.

The hard, broken and abrasive dolomites and sandstones extend from near surface to 1440 ft. Therefore, it was decided to penetrate to the latter depth with turbodrilling. From the 1440-ft point to total depth of about 2550 ft sub-surface, adequate weight-per-inch of bit diameter could be maintained, so conventional rotary techniques would be used.

Eight wells were to be drilled in the first phase of the program; two with the rotary rig and six with the turbodrill rig. An Ideco Mud-Master 600 pump was used to augment the turbodrill rig's original 300-hp pump as the Turbodrill requires fluid circulation at about 800 gpm.

A relatively small 96-ft jack-knife rig was used on the turbodrilled wells. The drawworks was rated at 3500 ft with 4.5-in. drill pipe. Dresser Industries' 80-stage, 10.25-in. OD Turbodrills were used.

Thirty feet of 20-in. water string casing was set through the overburden.

Then, the hole to 750 ft was drilled at 17.50-in. diameter and 13.375-in. casing was cemented in.

A 12.25-in. hole was drilled to 1440 ft and 9.375-in. casing set.

From 1440 ft to TD of about 2550 ft, an 8.75-in. hole was drilled and 7.0-in. casing run.

As previously mentioned, Turbodrills were used for the 17.50- and 12.25-in. hole. The 8.75-in. hole was drilled with conventional rotary equipment.

The first turbodrilled well—the Karcher M-3 (29)—required 9.5 days to reach the casing point at 1432 ft. Actually, only 84 drilling hours were required. Some time was lost for rig repairs and they lost circulation at 600 ft, which required a rotary bit run. And, turbodrilling got better with each well subsequently drilled (see *Fig. 1*).

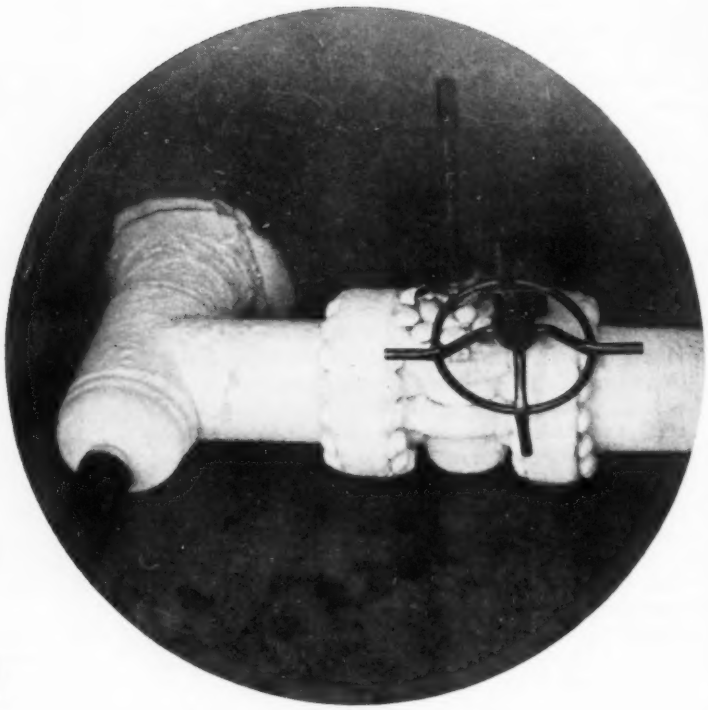
The first rotary well required 18 days to reach 1432 ft. It logged 12 days of rig repair and fishing for eight twist-offs. These problems were directly attributable to vibratory stress and strain from bit-bounce caused by running large rotary bits with limited weight in these hard-to-drill Herscher Dome formations. The second rotary well did better but still required three times as long to reach the 1430-ft casing point as the best turbodrilled well.

Fig. 2. Toolpusher and driller check play in the cones of a 17.50-in. rock bit attached to a Dresser Turbodrill.

Even below the 1430-ft casing point, the 8.75-in. hole went better on rotary bits from the turbodrilling rig because the big pump permitted jet-bits to be used. This additional hydraulic horsepower reduced small-hole drilling time from 19 days and eight bits, to about six days and four bits. So, time to reach TD for conventionally drilled rotary wells was 27 to 30 days, while the combination turbodrill and jet-bit wells required only 10 days.

It is interesting to note that turbodrilled holes showed less deviation than has been experienced in drilling in the Herscher Dome area with conventional rotary tools. Turbodrilled hole deviated only ¾ degrees or less from vertical. Previously drilled rotary holes produced much more serious deviation, and the 8.75-in. hole below turbodrilled sections deviated 1.5 to 3 degrees from vertical. There would seem to be important progress at hand with the turbodrill's ability to drill straight holes in crooked-hole country.

Certainly, turbodrilling has proved itself at Herscher Dome. It was in its element there and demonstrated its efficient performance under conditions ideal for its application. However, its has also been run in at other drilling sites through soft shales, sandy shales, red beds, salt, granite wash, anhydrite, hard lime, and chert, and has performed well. Turbodrilling shows a lot of promise for materially reducing drilling costs while producing better hole under some variety of drilling conditions. ■



Effects of hydrates on AUTOMATION

By WESLEY M. OWEN, Measurement Superintendent
Colorado Interstate Gas Co., Colorado Springs, Colo.

IN recent years increasing operating and labor costs per unit of production have caused management of more and more companies to evaluate the possibility of using automatic controls in the processing of their products to permit them to yield a higher productivity index per worker. The gas industry is no exception to this trend. Automatic control equipment in various individual applications is not new to the gas industry—they have been used for a number of years.

Before studying the effect hydrates might have on such a system, let us examine a fully automated gathering and transmission system as it might be constructed and operated.

Beginning with the gathering system, in addition to the current well facilities, a remotely controlled valve actuator, wellhead volume computer, together with the necessary transmission media and power supply would be required. The foregoing equipment would be coupled to a field computer, which would be the intelligence center for all of the control equipment in the area served by this computer. The computer would be designed and programmed to accept instructions from a local source or remotely from some other location. The computer would have fed into it at the beginning of each month the allowable of each well and would pick up from its memory storage the status as to overage and underage of production from the previous month. The computer would by periodically interrogating the wellhead volume computer of wells in production retain the cumulative production for the current month. Upon receiving instructions either remotely or from a local source to increase or decrease the total take from the field, it would compare the total production then being obtained. Through proration the computer would either increase or decrease the well production in accordance with each well's status as compared to its prorata share of the total allowable.

Each area would be controlled by its individual computer, which in turn would be controlled by a central source or computer which would have available to it data on all gas removed from the system either continuously or semi-continuously to permit it to have a system gas balance.

Compressor station computers would be available which could be instructed to hold a predetermined line pack upstream and downstream of the station

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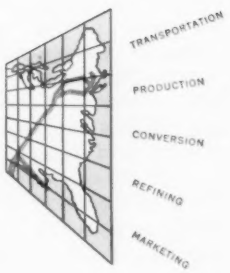


and programmed to adjust the compressor rpm, number of compressors, etc., to meet the conditions. The compressor computer would hold in its memory the line pack existing between it and the upstream and downstream station. Upon interrogation from the central point, it would transmit such knowledge to the central point. These data would complete the input and output from the system and allow a constant supervised control over the operation.

The central control computer would be a special type computer, feeding instructions to the field computer and compressor computers as required as to the overall system operations and particularly as to such computer's function in the overall operation. The servant computers would feed into the master computer periodically data on operations as might be necessary to permit the master computer to correlate the system balance and to compare against its memory whereby adjustment instructions might be made to the servant computers as required to perform their functions.

Weather data from weather stations located around the perimeter of the market area would be periodically fed to the master computer and would provide information whereby the computer could evaluate the approaching condition and make its own forecast. By utilizing a memory storage unit with the master computer containing data as to weather and load conditions for each sales area over an extended period of time, and including a factor based on increase of population for the same period of time to update the consumption data, the computer could compare any programmed change of weather approaching a sales area, predict its progress and arrival from additional weather data, verify its forecast and then by scanning its memory, determine the volume of gas required at such sales area. By comparing the predicted required volume against the volume being delivered, the master computer could instruct the compressor and field computers of the adjustment required to assure the new volume delivery at the proper time. The field computer would then prorate the increase or decrease to the wells and automatically adjust the well flows required.

Returning to the effects hydrates might have on this system, we will examine each component separately together with the suggested preventative or corrective measures to be followed to remedy the freezing conditions involved.

• Wellhead

Beginning at the wellhead, freezing in the wellhead or any related equipment at the wellhead would of course restrict or prevent the flow of gas as it now does using the present type of gathering techniques. However, with the automated system the field computer is periodically scanning each well to see how it is producing in relation to the instructions programmed into it. In the event the well is unable to feed, the computer would first try to determine if the downstream pressure is too great for the well to feed against. After determining that the fault is upstream of the wellhead volume computer, the computer would automatically make up the difference from other wells or cut another well into the system to make up the difference in volume expected from the well that is not feeding. The computer would then notify the local operator that trouble exists at the particular location and then continue with its scanning sequence of other wells.

How may freezing conditions at the wellhead be treated?

Preventative:

1. Addition of heat by use of indirect or direct-fired line heaters.
2. Addition of heat by placing flow line around Christmas tree circulating hot glycol or other liquid.
3. Use of bottom hole choke.
4. Adjusting flow as close to wellhead as possible.
5. Use of a lubricator or pump to inject inhibitor into the flow stream.

• Flow line

Freezing of the flow line between the wellhead and the measuring point would have approximately the same effect as that discussed for the wellhead.

How may freezing conditions in the flow line between wellhead and measuring point be treated?

Preventative:

1. Use of well dehydration.
2. Addition of heat.
3. Use of drips at low points.
4. Insertion of inhibitor ahead of measuring point.
5. Adjust flow rate at wellhead.
6. Maintain flow restrictions at minimum.
7. Keep flow line clean.
8. Insulation of above ground pipe.

Corrective:

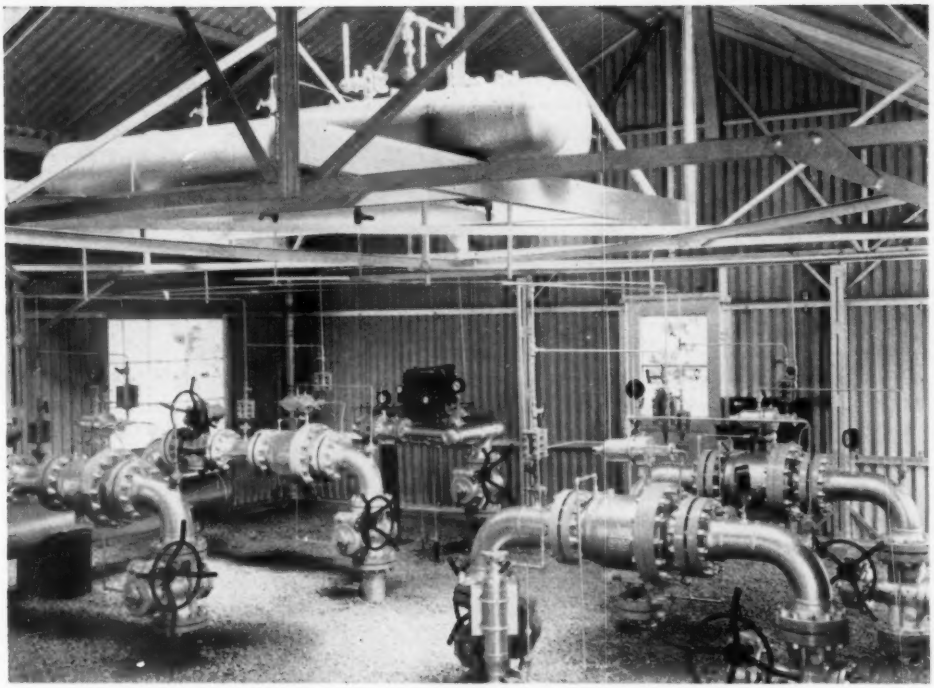
1. Isolate flow line section, blow down to atmosphere, inject inhibitor to accelerate action.
2. Blowing line.
3. In case of partial freeze, inject inhibitor upstream of block.

• Measuring equipment

The formation of ice and hydrates in the measuring equipment would probably be the most serious problem encountered in the field system. Since the field computer is periodically scanning the production from each well to see if it is producing its prorata share of the total volume required, erroneous volume data transmitted back to the computer would upset the gas balance from the area in which the malfunctioning equipment is located.

Preventative measures:

1. Dehydrate well stream.
2. Keep meter house tight and meter house heaters burning.
3. Eliminate leaks from meter piping. Use of teflon or O-ring packing for valves and pressure bearings.
4. Use ½-in. in preference to ¼-in. or ⅜-in. pipe for meter piping.



View of alcohol storage and injection system at regulator station.

5. Use of inhibitors in seal pots and by injection.
6. Avoid low points in horizontal meter lead lines.
7. Install metering equipment as close as possible to wellhead.
8. Install meter as near meter run as practical.

• Gathering lines

Formation of hydrates in the gathering lines would restrict or stop the flow of gas from the wells located upstream of the restriction or block. The field computer in its scanning sequence would try to adjust the flow from such wells to the most programmed volume required. When the wellhead valve actuator reached a certain preset limit without increasing the volume from the well, the field computer would then send a signal interrogating the wellhead volume computer as to the line pressure then existing at the measuring point. Finding that the pressure is higher than normal, the computer would start interrogating various locations on the field lateral downstream where pressure sensing elements are located. Finding an unusual pressure differential between the wellhead location and the pressure sensing location, the computer would then signal the local operator that trouble existed between the two points and make up the volume difference elsewhere.

Prevention of freezing in field gathering lines.

Preventative:

1. Dehydrate at wellhead.
2. Install line heaters.
3. Install line drips at low points and blow frequently.
4. Design gathering system to permit laterals to enter trunklines at not more than a 45° angle to the trunkline.
5. Avoid restrictions in gathering system and keep line clean.

Corrective:

1. In case of block, inject inhibitor and blow line down to atmosphere if necessary.

Assuming that up to this point we have passed the compressor station and if this much money has been spent on the before mentioned automatic devices, the company that has installed this system would have the foresight to also install a dehydration plant of sufficient size to handle the volume passing through such a system, from here on to the ultimate market area should be relatively free from hydrate trouble. However, we will list below the preventative measures to prevent the freezing at town-border stations (regulation).

1. Dehydrated gas.
2. Application of heat upstream of regulation.
3. Use of lubricators or pumps for injecting inhibitor upstream of regulators.
4. Proper design of regulators and sizing of ports.
5. Multiple pressure staging as justified by pressure reduction.
6. In use of pilot valves, use drier on gas supply.

Corrective:

1. Use of series-parallel regulator installations. ■

This article was adapted from a paper presented by the author at the Fifth Annual Gas Measurement Institute, Liberal, Kan.

GAS · PIPELINE NEWS

Beatrice gas to be diverted to insatiable California

Out West, things are popping. All of it involves new and additional gas supplies to Pacific Lighting Corp.'s southern California operating subsidiaries. While FPC twiddled its procedural and legalistic thumbs over the Beatrice project—which was designed to beef up the Midwest's critical gas supply—plans were made and contracts inked to divert some of the Beatrice project gas to southern California—also a natural gas hungry area.

Keys to the plans are dynamic Paul Kayser and the far-flung El Paso (Texas) Natural Gas Co. that he heads. Also involved (in addition to Southern California Gas Co., Southern Counties Gas Co., and Pacific Lighting Gas Supply Co.) are Colorado Interstate Gas Co., Colorado Springs, and Pacific Northwest Pipeline Corp., Salt Lake City. Incidentally, Paul Kayser was named president of Pacific Northwest early in August following exprexy Stuart Silloway's return to the financial factions in the East.

The basic deal is that Pacific Lighting Corp. will purchase an additional 550 MMcf per day of natural gas from El Paso Natural. The big Texas-based pipeline company will purchase 400 MMcf per day from Colorado Interstate and Pacific Northwest. Contracts have been signed calling for 200 million daily from each of the latter pipelines. The remaining 150 MMcf per day will come from Alberta under existing agreements with Westcoast Transmission, if the Canadian government's vacillating natural gas export policy permits.

The plans modify El Paso's Twin Falls project (see GAS, August, pp. 112-119) and mean rerouting of the physical side of that project. Now plans specify a 34-in. diameter, 400-mile pipeline from the California-Nevada border, just southwest of Las Vegas, to a point near Provo, Utah. From there, Colorado Interstate will build (probably through a new subsidiary) a 140-mile lateral to Rock Springs, Wyo. for connection with Interstate's lines from gas supply areas.

Colorado Interstate's 200 MMcf was previously committed to the Midwest via the Beatrice project. But both Interstate and Natural Gas Pipeline Co. of America have announced termination of their contract and most of the supporting applications. Now, this gas will be diverted to southern California.

Pacific Northwest's will also not be new gas. Its 200 MMcf daily will come from abrogation of the contract under which it now delivers 100 MMcf per day to Colorado Interstate; and by diversion into the new project of the 100 MMcf per day it has under contract to El Paso Natural.

As usual, however, all of this will require FPC certification, which can be a long, drawn-out matter. Pacific Lighting and El Paso hope delivery can start not later than Jan. 1, 1960 and build to the full contract volume by the same date in 1964.

Speculation has it that this California - Provo - Rock Springs project has a good chance for early certification. Also, the Transwestern Pipeline Co.'s certificate application seems to be dragging a bit. Transwestern hoped for early FPC approval of its line to bring additional gas to southern California. However, it had to amend its application filed in April and gasmen are talking about (while FPC raises an eyebrow) contracts that will have the new pipeline company paying 23 cents per Mcf for some gas, 21.8 cents per Mcf for some that will rise to 27.2 cents in '69, and an average price of over 18 cents per Mcf during initial operation. Some of this gas is coming from fields where around 12 cents per Mcf is about the average going rate.

Prices relevant to El Paso's Provo project were not announced by any of the principals involved. Nor was the estimated cost of the project available.

The new line that will replace the Twin Falls line will probably tie-in with Pacific Northwest's and Colorado Interstate's systems at Pacific's compressor station No. 6 near Rock Springs. Interstate's Rock Springs - Rawlins - Laramie-Denver system already joins Pacific at this point.

NGPL lets contracts for major expansion

August 1 was the starting date of construction on Natural Gas Pipeline Co.'s $82 million expansion program. Completion is expected by Jan. 1.

The 514-mile job will expand NGPL's pipeline mileage to more than 3700 and increase its system capacity by 100 MMcf per day.

R. H. Fulton & Co., Lubbock, Texas, will build 21 miles of 26-in. line from Fritch, Texas, northward, and 205 miles of 36-in. to a point

Henry J. Wallace (left), vice president-sales of U. S. Steel Corp.'s National Tube Division, explains a display showing the company's wide range of line pipe sizes—½ in. through 36 in. in diameter—to purchasing executives. They are (from left): Kenneth E. Haase, Peoples Natural Gas Co. and New York State Natural; Roy E. Adams, Equitable Gas; and Wayne L. Hutcheson, Manufacturers Light & Heat. The display was erected in the lobby of the U. S. Steel building in Pittsburgh.

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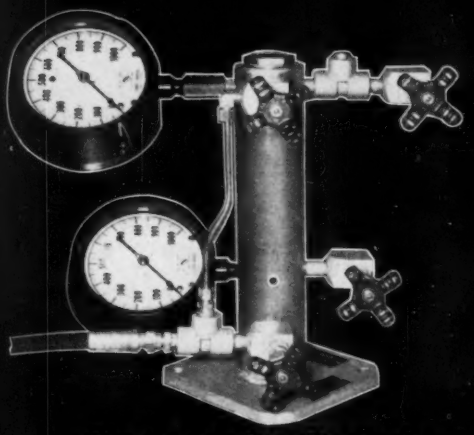

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near Meade, Kan. Fulton will also work on segments of the line from Offerle, Kan., to Lincoln, Kan.

Williams Brothers Inc., Tulsa, holds the contract for segments totaling 106 miles from Haddam, Kan., to Weeping Water, Neb. They will also work on the 99-mile section from Mt. Etna, Iowa, to Knoxville, Iowa.

Contracting Materials Co., Chicago, has an 81-mile section running from Muscatine, Iowa, to the Princeton, Ill., area.

NGPL recently filed with the SEC a registration statement covering the proposed sale to the public of $35 million of debentures, due July 1, 1978, and 150,000 shares of cumulative preferred stock, $100 par value.

Eskil I. Bjork, chairman of NGPL, said proceeds from the sale will be used principally to repay $44.5 million in bank loans obtained early in 1957 to temporarily finance two major construction projects.

The new financing will enable the Peoples Gas System to proceed with financing plans for the pending expansion projects of its NGPL subsidiary.

Houston Corp. seeks financing okay

Houston Corp., builder of the $226 million Texas-to-Florida pipeline, asked the SEC to register some $36.1 million of subordinate debentures and 1,809,400 shares of $1 par common stock.

In addition to owning all the stock of Coastal Transmission Corp. and Houston Texas Gas & Oil Corp., Houston Corp. listed acquisitions as follows: Manufactured gas distribution properties of Florida Power & Light Co. serving Miami, Lakeland, and Daytona Beach; manufactured gas distribution properties of South Atlantic Gas Co. serving Orlando and Winter Park; and LPG distribution facilities of Triangle Gas Co. serving Eustis, Mt. Dora and Umatilla.

According to Houston's prospectus, it will also acquire 80 per cent of the shares of common stock of Jacksonville Gas Corp., operator of distribution properties in Jacksonville.

Examiner okays Transco's complex plans

Oral arguments are under way on the major expansion of Transcontinental Gas Pipe Line Corp.'s system approved earlier by an FPC presiding examiner.

Four projects were covered by the $167 million okay. One of them was the joint filing of Transco, Texas Eastern Transmission Corp., and New York State Natural Gas Corp. This called for development and operation of the Leidy field and, eventually, the Tamarack field in Potter and Clinton counties, Pa., for the underground storage of gas.

Approved projects include:

1. Docket 13590, the largest, involving construction by Transco of facilities estimated to cost $137.3 million. Included: 556 miles of transmission line, 38,580 hp compressor power, and about 345 miles of purchase laterals to connect southern Louisiana, Texas, and offshore Louisiana gas supplies.

Transco will use these facilities to receive, purchase, transport and sell additional gas to 27 existing customers, and to store gas in Leidy for 10 existing customers. Transco also will move 50 MMcf per day for Consolidated Edison Co. of New York, and sell 10 MMcf daily to New York State Natural. The additional deliveries to 27 customers will total 173,634,000 cu ft daily. Storage service will be 191 MMcf daily.

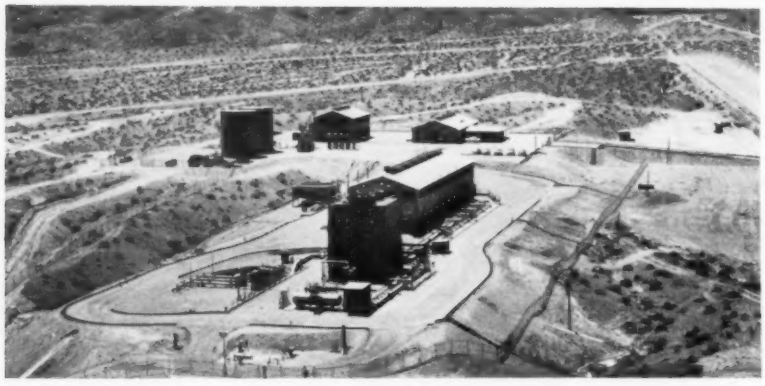
Docket 13590 was conditioned to require Transco to file cost-of-service type tariffs for both the sale to New York State Natural and for the storage service.

Con Edison plans to use its new gas supply for boiler fuel. In approving this transportation service, Examiner William J. Costello said that while consideration must be given to pipeline capacity and to the rate, the FPC has no legal basis for inquiry into the merits of the proposed end use so long as that use has no relationship or effect upon consumer service stemming from jurisdictional natural gas.

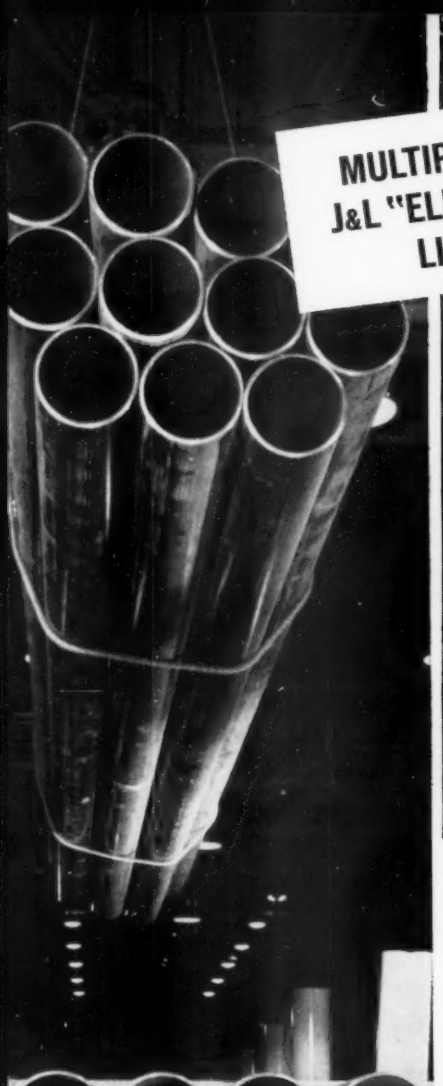
Con Edison will buy the gas at 19.25 cents per Mcf from producers in Texas for transport to New York City by Transco. The transportation service may be stopped for as many as 60 days each year, during which time Transco will furnish a like amount of gas on a firm basis for general system use by Con Edison. Transportation charge will be 23.38 cents per Mcf. The price of gas which Transco sells to the New York City utility will be 34.23 cents.

2. Under the Leidy storage program (Docket G-13793) a three-company plan (Transco, Texas Eastern, and New York State Natural) will result in the development

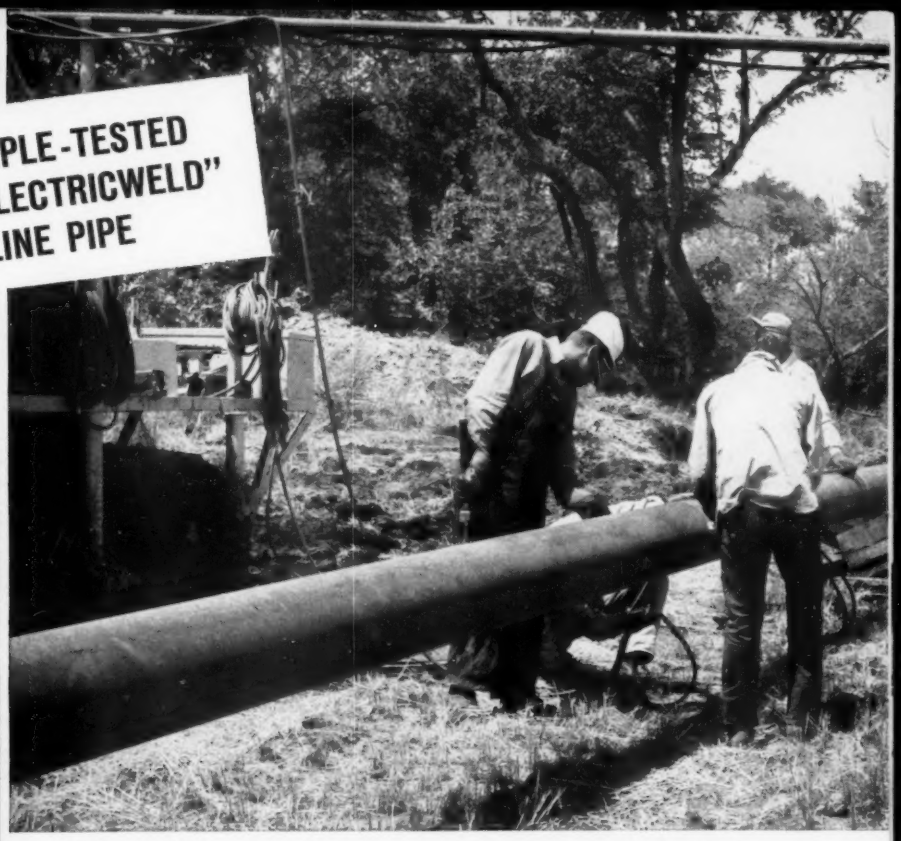
Continued on page 124



Aerial view of the new Southern California-Southern Counties Gas compressor station located at Needles, Calif. Located on the 60-acre site near the California-Arizona border are four 2000-hp gas-fueled, turbo-charged compressors. The Needles pipeline adds a designed capacity of 227.6 MMcf of gas daily to the capacity of the companies' other two existing lines. Space is provided for a fifth compressor, which is planned for use prior to 1960.



MULTIPLE-TESTED J&L "ELECTRICWELD" LINE PIPE



Welders on this Jayhawk Pipe Line Company installation report J&L Electricweld pipe is easy to weld. They installed 3109 tons of 10¼-inch O.D. and 3172 tons of 12¾-inch O.D. Electricweld pipe in this line. Both sizes are in .250 inch wall and Grade X46.

Jayhawk relies on J&L "Electricweld" line pipe for 78 miles of dependable performance

The Jayhawk Pipe Line Company, Wichita, used 42 miles of 10″ and 36 miles of 12″ J&L Electricweld line pipe in this new line from Plains to Valley Center, in Kansas. They find that J&L Electricweld line pipe bends readily, is uniformly round, is consistently top quality.

Electricweld line pipe is produced by Jones & Laughlin under most rigid quality controls. J&L, an integrated steel company, is able to control quality from ore through finished pipe. J&L takes every step to assure unsurpassed quality and dependability in Electricweld.

Before welding, the skelp edges are blasted with steel grit under 100 psi in a "Vacu-Blast" unit to clean the surface for perfect contact with the welding electrode. Electronic controls maintain exact welding heats at all speeds. After welding and trimming, the pipe passes through an induction annealing unit to assure uniform grain structure in the weld area.

Every length is thoroughly inspected through visual examinations, hydrostatic tests, flattening tests and magnaflux examinations. All J&L Electricweld line pipe is manufactured and tested in strict compliance with appropriate A.P.I. and A.S.T.M. specifications.

Electricweld line pipe is available from 6⅝ inches through 12¾ inches and in lengths to 60 feet. Investigate this superior-quality pipe for your next line. See your distributor, or write to Jones & Laughlin Steel Corporation, 3 Gateway Center, Pittsburgh 30, Pa.

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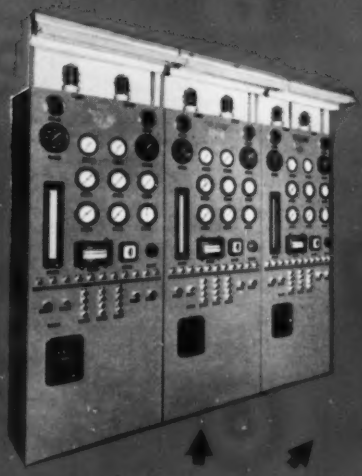
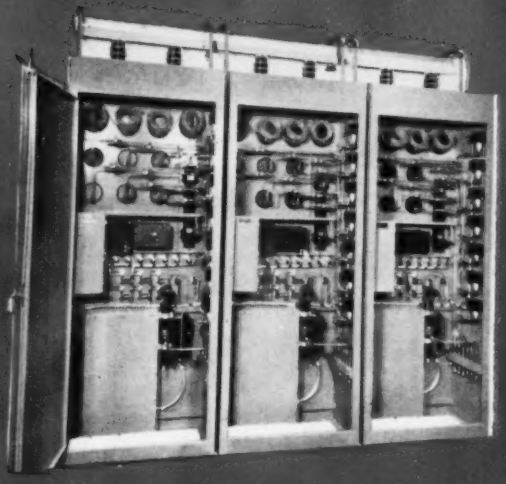
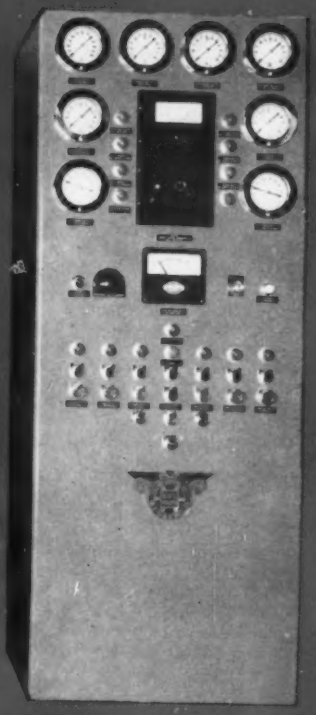


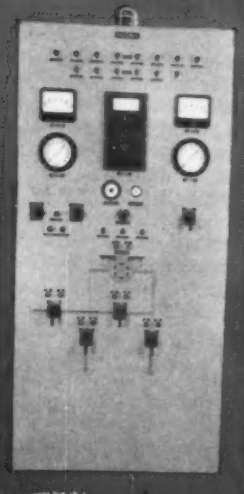


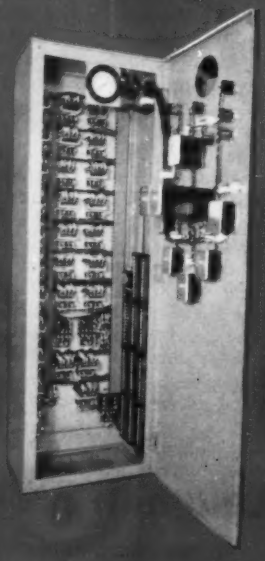
En-Tronics for Mid Valley Pipeline — console control of pipeline boosters.

EN-

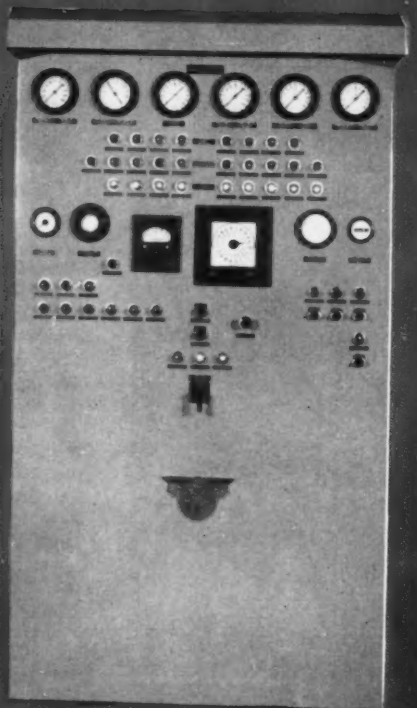


En-Tronics for Transcontinental Gas Pipeline—automatic starting and loading of engine-driven centrifugal compressors.





En-Tronics for Southern Natural — local-remote control of packaged compressor units.



En-Tronics for Belridge Oil—remote automatic control of engine generator unit in oil field generation service.

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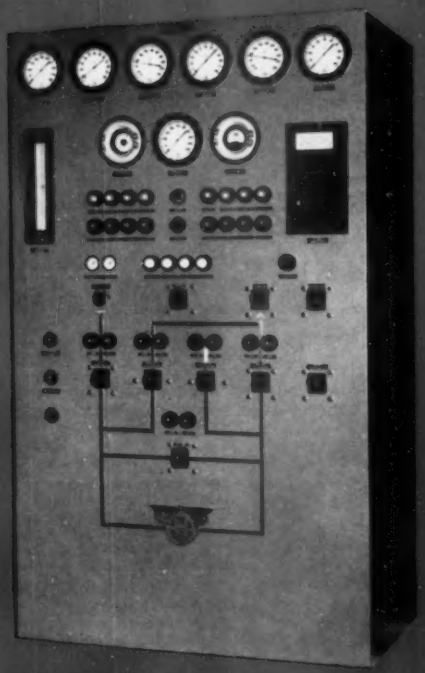

En-Tronics for Northern Natural — fully automatic sequence control of engines and compressors in gas transmission service.

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En-Tronic controls may be applied to any phase of engine and compressor operation including local automatic, remote automatic and program automatic.

- ***EFFICIENCY***

Automatic starting, loading, regulating and shutting down of power equipment with dependability, safety and new economy.

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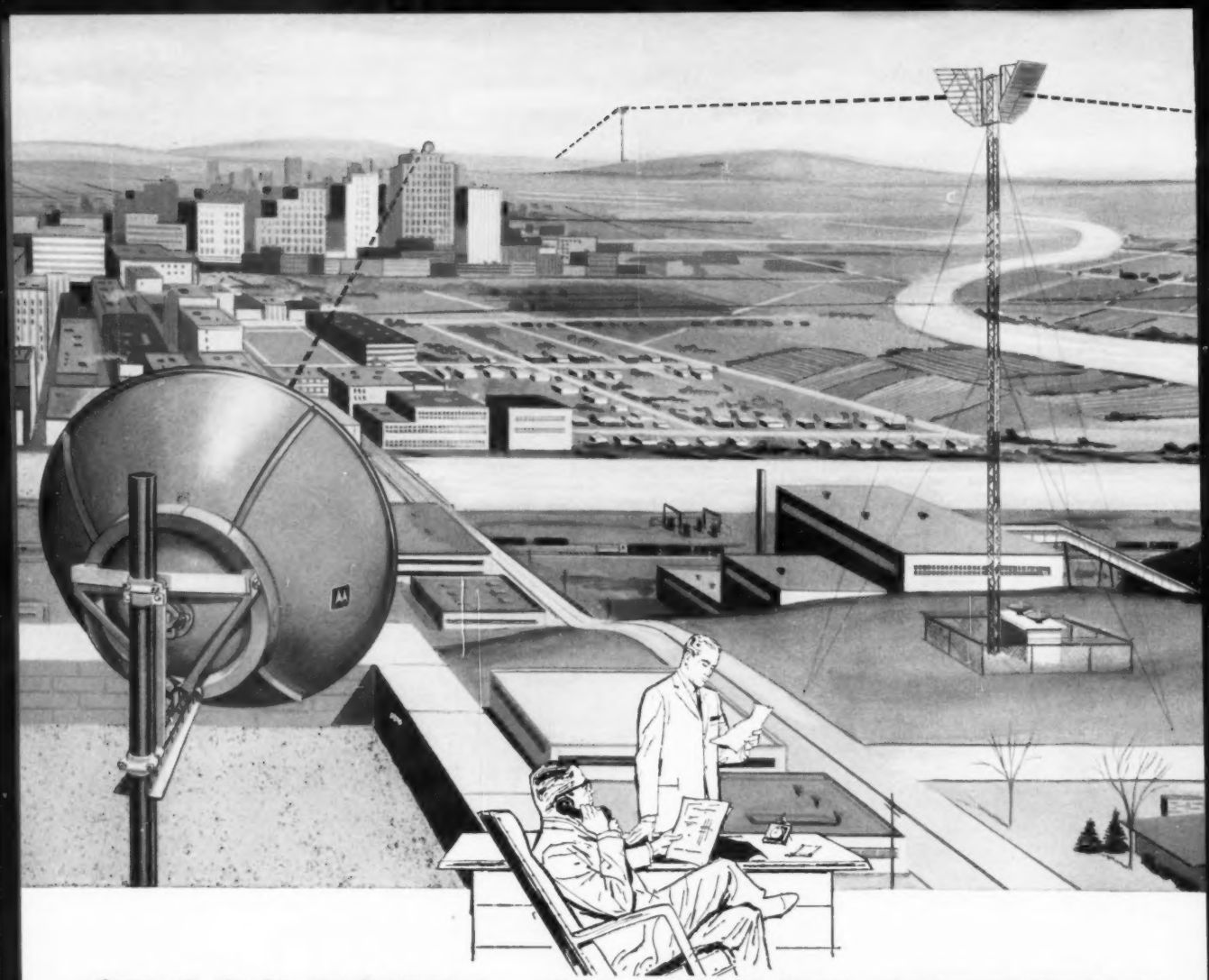

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Edited by FRANK CHAPMAN

A primer of telecontrol signals

By F. VINTON LONG

THERE are two basic methods used to transmit supervisory control intelligence. Both have advantages and both have been used for a long time.

First, I will describe the pulsing method. Basically, the intelligence consists of a series of d-c pulses, exactly as your home telephone dial operates.

In its simplest form, a certain number of pulses are transmitted, from 1 to 10, and a receiving relay counts them by moving a step for each pulse. Your home telephone circuit does this and some of the simpler control boxes such as the Bell 64C1. You set up the counting relays so that if you dial certain numbers, such as 943, the final counting relay will come to rest on a contact which energizes another relay which will do something such as ring a bell, switch a teletype machine to another circuit, start a motor, etc.

If this intelligence is used for short-haul work, such as within a city, d-c operation is used entirely. If longer distances are involved, the d-c pulse is converted to a tone, transmitted by carrier to the distant point, and changed back to a d-c signal. This signal is capable of two conditions, on or off.

This equipment is cheap and simple. It will operate on a cheap 15-cycle, band-pass, signalling-grade leased line which in interstate service will cost about 75 cents per mile per month. Intrastate or short-haul service might cost double or more this amount.

One pulse added or missed can make the receiving relay step to the wrong number, such as happens when you dial the right telephone number but get the wrong party. Because a pulse can be induced on the circuit by noise or lightning or loose connections, it is quite easy for the receiving relay to be fooled and give incorrect operation because as far as it is concerned a pulse is a pulse whether accidental or intentional.

This is common knowledge to the common carriers and they do not recommend this type equipment for long-haul and vital control use.

Another example of simple coding, such as your telephone, is the teletype circuit. You have probably wondered many times how the teletype operators could garble and misspell so many words in a short message. The answer is that they don't. They type it correctly and the transmitting machine sends it correctly, but somewhere along the line a burst of noise gets in and adds an extra pulse or so, and the receiving machine prints just what it sees, which in this case could be wrong. That is the reason you so often see vital information such as numbers, repeated at the bottom of a message.

Because it can be transmitted on a cheap or narrow band-pass signalling channel, most of the commercial suppliers of supervisory control equipment use d-c pulsing techniques. So does the Bell System SC-2.

However, they usually employ a more complicated or complex code to transmit intelligence. They make it difficult for a momentary circuit outage or a burst of noise to fool the receiving relays.

Picking the type of coding is quite a problem because of the basic limitation of what can be done with a pulse combination to make it look unlike any other combination sent intentionally or received accidentally because of circuit noise.

There are two things you can do.

1. Vary the length of a pulse.
2. Vary the separation between pulses.

Use of either type or a combination of the two will greatly improve operation over ordinary "home telephone dial" equipment.

For instance, the SC-2 has an extremely complex code available for critical orders by checking: (1) Time, (2) bits, (3) number of long pulses, and in some cases the codes are sent twice and must be received correctly both times. A complex code in redundancy is used on all orders, but only the control points have complete coding equipment. The controlled or satellite locations have only checking equipment and keyers for sending back simple codes such as one long, two short, etc.

Most of the commercial pulse type equipments use the "check-back" feature to advise the operator that he has selected the function that he called for. The SC-2, depending on its "double count" complex code, does not employ this.

The digital type of control equipment falls into the pulsing category.

The advantages of pulse techniques? First, the simpler forms are usually cheaper, and all forms operate on a comparatively cheap line if leased lines are used. And a narrow-band channel is easier to derive from a crowded communica-

tion circuit and sometimes is the only thing available. A narrow channel is easy to maintain.

The disadvantages? First, there is sometimes difficulty of insuring against malfunctions, especially in the simpler coding types. Also, up to now simplex operation has been used, which loses the operating advantage of full duplex sometimes desired. (Full duplex operation permits you to simultaneously send out orders while feedback intelligence is returning to you.) Of course, most of them can be converted to duplex operation by some redesign.

In one simplex-type operation, several satellite or controlled stations and their control station are all connected in series so that if a line break occurs at any one of these points, the entire system within the control sector becomes inoperative until the break is bridged across. This could be a serious operational hazard, but can be cured by a little more outlay for line facilities.

It should be brought out that there are an awful lot of people who use pulsing type supervisory equipment and swear by it.

The other basic method used for supervisory control work is the sequential-tone technique.

This involves the use of several different audio tones, usually within the range from 400 to 3000 cycles. Each tone is generated by a tone transmitter, usually electronic and each tone is transmitted down the line when called upon by action of a sending relay.

Pushing a control button will cause a combination of several different tones to be sent one at a time, in proper sequence, down the line to the receiving station.

As each separate tone arrives, each of a different frequency or "pitch," and if they are spaced correctly in reception, each relay which is tuned to receive only that particular tone will operate, in proper sequence, until the right combination is hit and a final activating relay will pull up and control something.

There are three things that you can do to encode tone signalling:

1. Send individual frequencies or "pitches" for each order.

2. Send these combinations in a certain sequence.

3. Send them with the proper spacing or timing between each tone.

Sequential-tone operation uses the combination of all three shown above.

Advantages: First, use of the complex combination of tone, sequence, and time elements, outlined above, makes the system highly resistant to malfunctions caused by intermittent or random noise.

Second, the use of fewer counting chain relays made possible by use of different tones makes maintenance and trouble shooting a simple matter.

Thirdly, full duplex operation is available if desired, so that the operator can continuously monitor the condition of the station he controls while simultaneously transmitting orders.

Disadvantages: Telephone-grade channel is required, which involves considerably higher cost if leased lines are employed. This does not apply if multi-channel microwave is used. This channel will have a basic cost of $3 per mile per month on interstate service, and up to double or more than on short-haul intrastate service.

Use of a wide-band channel means more difficulty in providing sufficient band-pass width, especially with high-line electric power transmission carrier. Diligence must be observed to provide this, and also a "flat" line is required, so that a tone of one frequency is not received much weaker or stronger than the other tones.

Turn to page 124

FCC RULES FOR GAS COMPANIES

ELIGIBILITY	* Changes Instituted by FCC Dockets Nos. 11991 & 12295.
A. *Under the Petroleum Radio Service* Any company engaged in prospecting for, producing, collecting, refining or transporting by pipeline, natural gas or petroleum products.	More channels available derived from "channel-splitting" techniques.
B. *Under the Power Radio Service* Any company engaged in pipeline distribution of artificial or natural gas or that activity combined with production, transmission and storage of gas.	More channels available derived from "channel-splitting" techniques.
C. *Under the Special Industrial Radio Service* Any company engaged in construction of, maintenance of or specialized services to gas production, transmission, storage and distribution activities.	More channels available derived from "channel-splitting" techniques. Geographical limitations (use outside of metropolitan areas only) removed from previous rules.
D. *Under the Business Radio Service* Any legitimate commercial enterprise.	New service adopted which can accommodate organizations not eligible under the above "higher priority" services as well as "overflow" from these services.

* Existing licensees are affected as follows:

1. After 8/1/58 all newly licensed systems must meet "split-channel" standards in full.
2. By 2/1/59 all existing licensees in the 25-50 mc and 152-174 mc bands must reduce transmitter modulation deviation from ±15 kc to ±5 kc.
3. By 11/1/63 all existing licensees must comply, in full, with the FCC "split-channel" technical standards for transmitters (higher stability and audio spectrum limiting may be required by some equipment).
4. At the option of the licensee, receiver conversion can be accomplished
   a. Compensate for decreased transmitter modulation deviation for best receiver output and signal-to-noise ratio performance.
   b. Convert to narrow band selectivity to provide maximum protection from adjacent "split-channel" transmitters.

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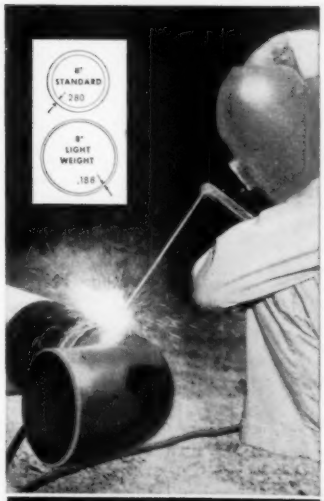

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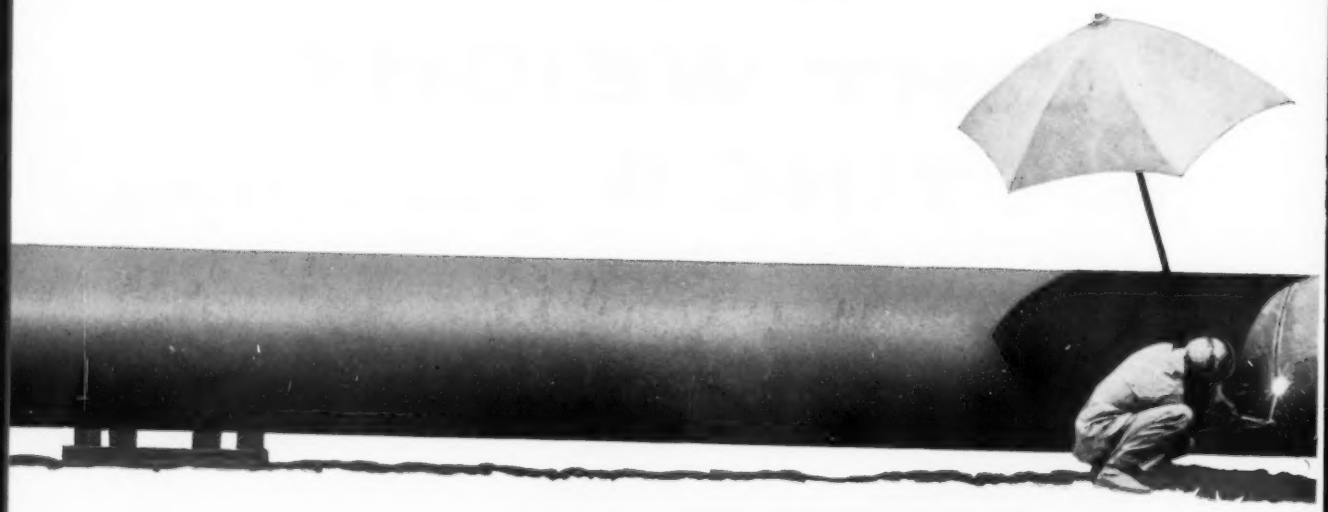
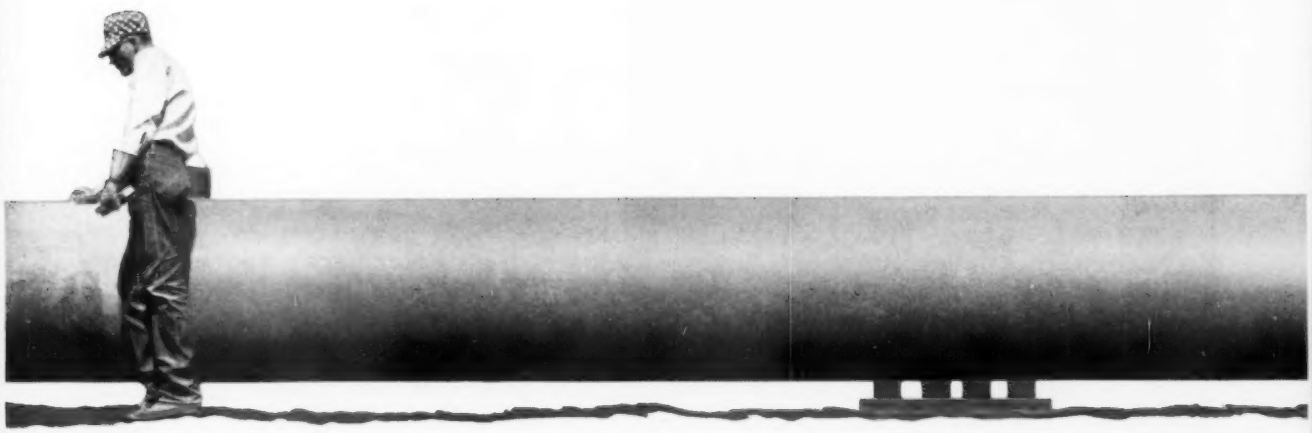
LINE PIPE to 42 in.





BETHLEHEM STEEL LINE PIPE—now produced to 42 inches OD—is manufactured to the specifications shown below.

	SIZES (in., OD)	WALL THICKNESSES (in.)	LENGTHS	SPECIFICATIONS
HYDRAULICALLY EXPANDED ELECTRIC FUSION-WELD (submerged arc)	22 and 24 26 through 36 36 through 42①	¼ to .0438 incl. ¼ to ⅝ incl.① ¼ to ¾ incl.①	40-ft②	API 5LX, Grades X42, X46, X52 & X56①
ELECTRIC RESISTANCE-WELD	5 (nom) to 16	API	to 60-ft	API 5L, Grades A & B API 5LX, Grades X42 & X46
CONTINUOUS BUTT-WELD	½ to 4 (nom)	API	SRL 24 to 26-ft DRL to 50-ft	API 5L, ASTM 120; ASTM 53
COMPRESSOR STATION PIPE	in diameters, thicknesses, and lengths as required; fabricated from as-rolled, high-strength Mayari R steel; made in accordance with Sec. 8 of ASA B 31. 21.8—1955.			

① For sizes, thicknesses, and physical properties exceeding present API 5LX specifications, official API monogram cannot be applied.
② Expanded after two 20-ft lengths are joined with girth weld. ③ Also available in random lengths.

Let us quote on your requirements now. For early delivery, contact the Bethlehem sales office nearest you.

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BETHLEHEM STEEL

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Because the channel is required to transmit tones of several frequencies, and a channel has a certain maximum power transmitting limit composed of simultaneous transmission of several tones, the strength or volume of each individual tone must be reduced so that the total does not exceed the limit of the landline or microwave system. This is sometimes a burden.

Sometimes a wide-band channel is not available at any price.

The common-carrier engineers have been most cooperative in working with their pipeline customers and control-equipment supplier engineers in designing and providing communication channels satisfactorily for this use.

Use of several tone generators increases the number of electronic parts such as tubes.

Sometimes sequential-tone equipment is more expensive than the simpler types of pulsing equipment.

Again, as in the case of pulsing type users, there are just an awful lot of satisfied sequential tone customers.

In conclusion I would like to say that if extreme reliability and operational flexibility are required, then any money spent is well worth while. In other cases, this performance is not required and may not be worth the money. The one thing that is worth the money, however, is the engineering time devoted to each installation on a case-by-case basis. Management will take note of this. ■

pipeline news • *Cont'd.*

from page 114

and activation of the field to be used by the three companies. New York Natural, present owner, will transfer a one-quarter interest each to Transco and Texas Eastern, retaining the 50 per cent interest and acting as operator of the storage properties. Initially, about 15 billion cu ft of top storage gas and 20 billion cu ft of base storage will be provided at Leidy. Initial development costs, to be borne by Transco, are estimated at $12.4 million. Transco is the only partner planning to use the initial storage capacity.

3. The third project okayed (Docket G-13143) calls for construction of about 151 miles of purchase laterals running from fields in LaFourche and Saint Charles parishes, La., to Transco's mainline near the Mississippi-Louisiana border. Estimated cost: $14.5 million.

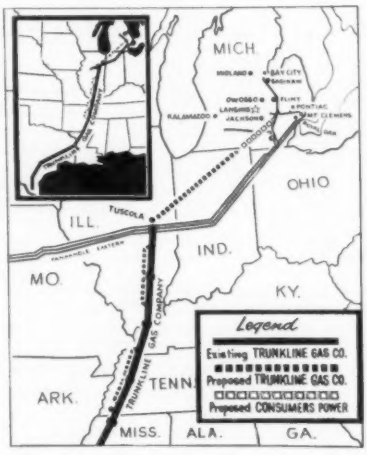
4. The fourth docket (G-13745) covers installation of an additional 10,000 hp in mainline stations. This will enable Transco to provide up to 22 MMcf daily of firm long-term deliveries to Atlanta (Ga.) Gas Light Co. Cost: $2.9 million.

While not covered in the original applications, the examiner directed Transco to serve several intervenors-prospective customers. Pittston (Pa.) Gas Co. and City Gas Co. (Phillipsburg, N.J.) would receive service through Transco's Leidy storage line. Lynchburg Pipe Line Co., a subsidiary of Lynchburg (Va.) Gas Co., would use its new gas supply to supply a single industrial customer and provide support for the Lynchburg system during peak periods. The examiner's order also provides for a moderate increase in the gas sold by Transco to Georgia Gas Co. division of United Cities Gas Co. for use in Gainesville, Ga.

FPC gets $6.3 million '59 appropriation

The $6.3 million appropriation asked for by the FPC for the fiscal year 1959 was granted.

After the House cut it back to $6 million, the Senate restored the total requested. In an appeal to the Senate Appropriations Subcommittee, FPC Chairman Kuykendall said that if the House cut stood, it "would mean a reduction of about 30 per cent in the increase requested . . . for gas work."



Map shows existing facilities of Trunkline Gas Co. Under an $81.5 million expansion program announced recently, trunkline will extend its mainline from Tuscola, Ill., northeast to the Indiana-Michigan boundary to provide Consumers Power Co. with 100 MMcf daily. Consumers Power will construct facilities from the Indiana-Michigan delivery point and feed the new gas supplies into its outstate Michigan distribution system.

Even with the $6,385,000 granted, Chairman Kuykendall testified that a supplemental $120,000 will be needed to piece out 1959. "It will be three years before we can handle gas certificate work on a current basis," he said.

Northern's Redfield compressor okayed

In a step to prove out the feasibility of the Redfield storage project, the FPC has granted Nothern Natural Gas Co. a temporary certificate (Docket G-13875) for a 2000-hp compressor station at the Iowa field. Earlier, the commission denied Northern a certificate covering permanent operation of the storage project (G-2460, 2306, et al).

Under the present permit, the maximum inventory of gas in the Mt. Simon formation is limited to 8 billion cu ft. Nothern is also required to file information relating to the evaluation of this formation as a gas storage reservoir.

Pilot operation at Herscher authorized

Plans of Natural Gas Storage Co., Chicago, to inject gas into a new formation in its Herscher underground storage reservoir have an FPC okay (Docket G-14872).

The $2.5 million job includes 12 injection-withdrawal wells, about 2.4 miles of gathering lines, a 1330-hp compressor plant, and three observation wells. The company plans a pilot operation for initial limited development of the Mount Simon formation, lying about 600 ft below the Galesville sand, now used as a storage reservoir in the Herscher area.

About 5 billion cu ft will be injected this year, with about 3 billion required as cushion gas.

2 *Machines in* 1

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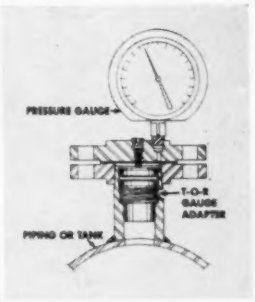
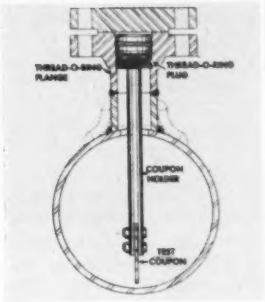
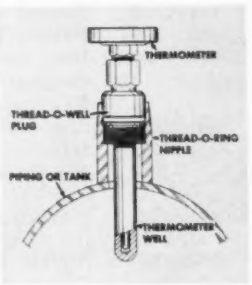
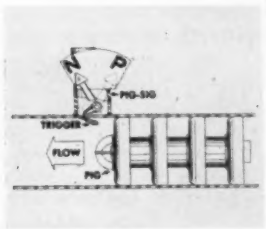




⟵ CORROSION TEST COUPONS

THERMOMETER WELLS ⟶





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Southern California Gas Co., Los Angeles, went into great detail to provide for the minimum noise criteria at its Ducommun Street compressor station. After a thorough study, SoCal installed Burgess-Manning's special air intake cleaner-silencers and special side inlet exhaust snubbers on each of the Ingersoll-Rand gas engine-driven compressors. The Burgess-Manning equipment was designed for vertical installation and as they are approximately the same size, they appear to be a "matched set."

Ohio Fuel's Medina storage plan approved

Ohio Fuel Gas Co., Columbus, has an FPC certificate (Docket G-14269) to build and operate facilities needed to convert the depleted Medina gas producing field in Medina county, Ohio, into an underground gas storage area.

Initially, the project includes a 3300-hp compressor station and a gas injection and withdrawal system. This consists of 12.4 miles of pipe ranging from 4 to 20 in. in diameter. Ultimately the company plans to drill 72 additional wells and build necessary well lines for full development of the field.

Ultimate storage inventory is estimated at 8.5 billion cu ft, with 7.7 billion due for injection by Nov. 1, 1961. This would give an active storage volume of 3.4 billion cu ft over the proposed 4.3 billion cu ft of cushion gas.

Estimated total investment in the Medina pool is $5 million.

Colorado gas for PNW

Seven independent producers in Rio Blanco county, Colo., will be supplying gas to Pacific Northwest Pipeline Corp. The FPC granted PNW a certificate (Docket G-13456, et al) to build a mainline tap and lateral supply lines to pick up the gas.

Total amount of gas is 100 billion cu ft. Now deliverable from the Kadane well is an estimated 1.5 MMcf daily. Pacific plans to take an average of 1 MMcf daily during the first five years. Proposed initial price for the gas will be 15 or 16 cents per Mcf, depending on the delivery pressure.

SRS • Pipeline Notes

Atlantic Seaboard Corp., Charleston, W. Va., has a temporary certificate to spend some $2 million on 17.7 miles of 26-in. line in West Virginia and Virginia (Docket G-15129). The line will parallel sections of the company's existing system between the Seneca and Lost River compressor stations. About 36.5 MMcf will be added to the daily system capacity of the company.

SEC authorized Columbia Gas System's purchase of Gulf Interstate Gas Co. The SEC noted that under its order, Columbia Gas will have to divest itself of the Gulf stock if it doesn't eventually acquire all Gulf's facilities as now planned.

Natural Gas Pipeline Co.'s 3000-hp compressor station in Kiowa county, Okla., has been given the go-ahead by the FPC (Docket G-12399). In June the commission granted NGPL temporary authority for construction of other facilities proposed in this application, including about 490 miles of 36-in. and 21 miles of 26-in. loops between Fritch, Texas, and Joliet, Ill. NGPL subsequently found that the 3000-hp station was needed to provide the increased system sales delivery capacity of 100 MMcf daily.

A revised edition of the FPC's "Regulations Under the Natural Gas Act (With Approved Forms)" is now on sale by the Superintendent of Documents, Washington 25, D. C. Price is 35 cents. It contains Subchapters E and G, Regulations under the Natural Gas Act, with approved forms, of the FPC's rules and regulations in effect as of June 30, 1958.

The FPC authorized Texas Eastern Transmission Corp. (Docket G-14226) to construct and operate a 6600-hp compressor station near Blessing, Matagorda county, Texas. The $2.3 million station is at the junction of Texas Eastern's 30-in. Vidor-McAllen and 24-in. Provident City-Blessing lines.

Algonquin Gas Transmission Corp.'s proposed 4000-hp compressor station at Cromwell, Conn., has an FPC certificate (Docket G-14876). At present, Algonquin's margin of safety is 7.1 MMcf, or 3 per cent of capacity. With the additional facilities, the margin will be 34.5 MMcf.

Thirty-four miles of 20-in. line and a regulating station have been certificated by the FPC for Manufacturers Light & Heat Co., Pittsburgh. The $3 million job will be installed in Greene, Adams, and York counties, Pa.

Southern Union Gas Co.'s 12-in. line augmenting the gas supply to Albuquerque, Santa Fe and Belen, N. M., is slated for completion the 1st of September. Gas will come from wells in Ballard Pictured Cliffs, Dogie Canyon and Jicarilla fields in the San Juan basin.

Michigan Gas Storage Co.'s plan (Docket G-14465) to meet increased demands of Consumers Power Co., its sole customer, has been given the nod by FPC. The company will spend an estimated $3.9 million on 40 miles of 26-in. lines and 25 new wells in the Winterfield and Cranberry Lake storage fields, together with facilities to connect the new wells to existing gathering systems.

New York State Natural Gas Corp. has a certificate for Docket G-14957 covering 13 miles of 20-in. line in Potter county, Pa. It replaces 12.9 miles of 12-in. The new line will run from the company's Harrison storage field in Potter county. Capacity of the new line will be 284 MMcf daily, compared with the 88.8 MMcf for the existing line.

Oil and natural gas industry activities in 29 states are discussed in a free booklet published by the Independent Petroleum Association of America, P. O. Box 1019, Tulsa. Answers to some 50 basic questions about the economy and natural resources of the states with established oil and gas production are presented.

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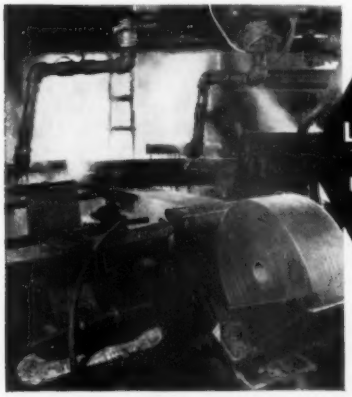

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Dr. D. E. Holcomb
El Paso Natural

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Clark Bros.

Glover Cary Jr.
Texas Gas

DONALD L. SEDGWICK is a newly elected vice president of Northern Natural Gas Co., Omaha. Mr. Sedgwick is general manager for Peoples Natural Gas division of Northern. Prior to his appointment as general manager in May of this year, Mr. Sedgwick was director of marketing for Northern.

Two new vice presidents have been elected by Union Producing Co.'s board of directors. J. B. STOREY is vice president in charge of drilling and production of the wholly owned subsidiary of United Gas Corp. FRED R. SCHROEDER is vice president in charge of exploration, a newly created post. Mr. Storey is filling the vacancy created by the retirement of W. J. QUIGLES, senior vice president of the producing company and one of the real veterans of the gas and oil industry in the Gulf South. Mr. Storey has been with the United Gas organization since 1935, when he joined United's pipeline company. Mr. Schroeder, a 28-year employee of United, joined a predecessor company in 1930 as geological scout in the Shreveport district.

STEPHEN D. BECHTEL JR. has been added by the board of directors of Tennessee Gas Transmission Co., Houston. Mr. Bechtel is executive vice president and director of Bechtel Corp. of San Francisco.

GLOVER H. CARY JR. is the newly appointed manager of industrial development of Texas Gas Transmission Corp., Owensboro. He will supervise and coordinate a staff of industrial representatives whose mission is to advise and inform site-seeking industries about the many advantages of locations in areas within proximity of the company's service area.

JACK O. O'BRIEN has been promoted to district exploration manager, Calgary (Canada) district by Tennessee Gas Transmission Co. With TGT since 1955, Mr. O'Brien formerly was district geologist at Calgary.

DR. DYSART E. HOLCOMB, president of Texas Western College, has resigned that post to become director of research and development for El Paso (Texas) Natural Gas Co. TOM POFHAL, chief research engineer at El Paso Natural, will remain in that capacity. Dr. Holcomb will be in charge of all research and development for El Paso and its subsidiaries.

Tennessee Gas Transmission Co., Houston, has formed a new exploration studies group. The new group will handle special geologic studies for both the domestic and overseas exploration departments of the company. It has been staffed initially by DR. H. J. HARRINGTON, who was named chief of exploration studies, and two senior geologists, J. W. KEITH and DR. MORAD MALEK-ASLANI.

GEORGE STEVEN is general manager of the compressor and engine division of Worthington Corp., Buffalo, N. Y. Mr. Steven formerly was assistant general manager at the Buffalo division.

R. E. WILSON has been named manager, communications manufacturing, by the Radio Corp. of America.

R. C. MCDONALD is the newly appointed New York district manager for Clark Bros. Co., one of the Dresser Industries. He succeeds ROBERT J. SPEARS, who recently became assistant general sales manager. Since 1953, Mr. McDonald has been in charge of the company's Philadelphia district office.

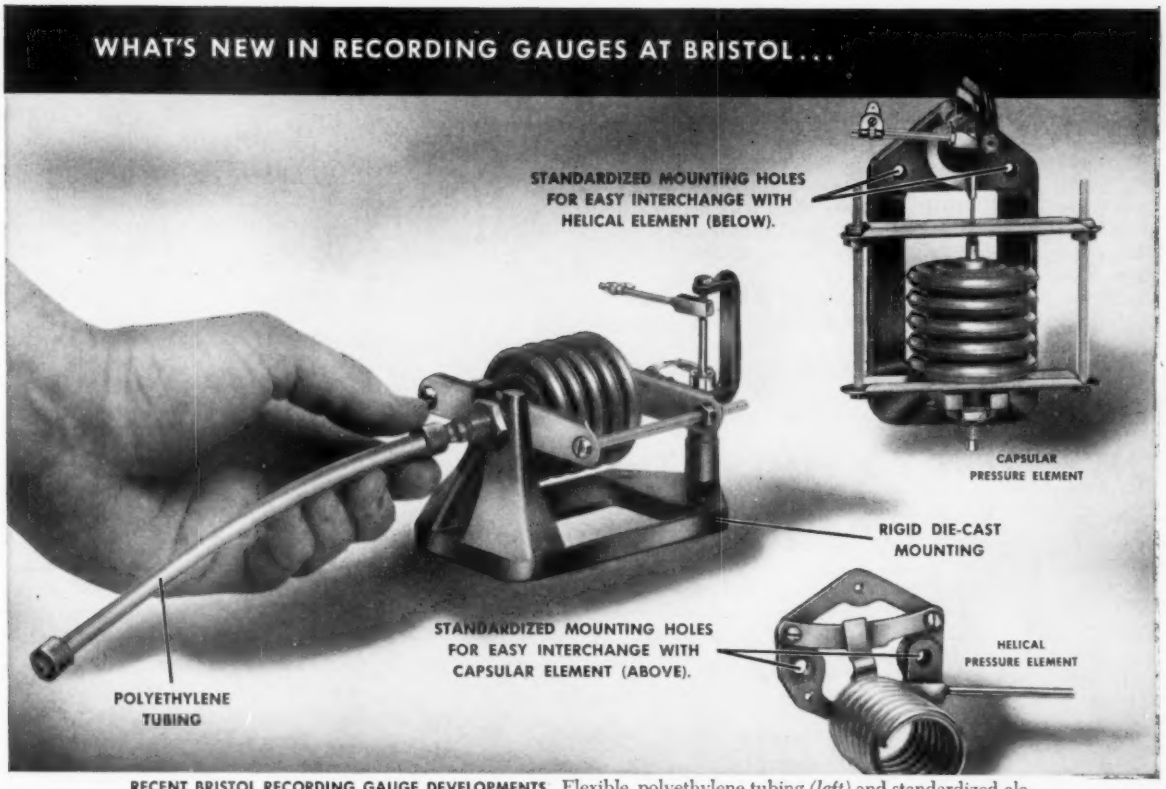
MELVIN A. FINUF, manager of sales since May 1957, has moved up to the staff of the executive vice president of the J. B. Beaird Co. Inc., Shreveport. Mr. Finuf will serve as marketing assistant.

GUILLERMO FREYTAG has been appointed branch manager of Cooper-Bessemer Corp.'s Mexico City office. Mr. Freytag has been associated with Cooper-Bessemer in both the engineering and application of reciprocating and centrifugal compressors.

WILBERT E. LULEY has been named sales engineer in the Chicago office of Buflovak Equipment division, Blaw-Knox Co., Buffalo, N. Y.

WALTON L. MCKINLEY is direct company sales representative for the ACF lubricated plug valve, W-K-M division of ACF Industries Inc. Mr. McKinley will be located in Jacksonville, Fla., and will cover Florida, Tennessee, Alabama, Georgia, and the Carolinas.

Several appointments have been announced by Black, Sivalls & Bryson Inc. CHARLES R. BOOTZ is man-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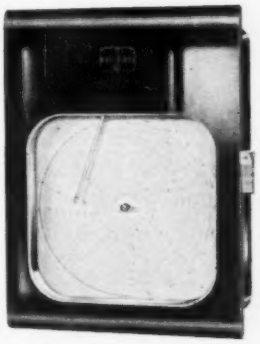

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pipeline people • *Cont'd.*

ager of the company's Controls division in Tulsa. For the past two years, Mr. Bootz has been manager of BS&B's nuclear project at Tulsa. M. STEVE WORLEY is chief development engineer for the company's Oilfield Equipment division in Oklahoma City. Sales headquarters for the West Texas-Rocky Mountain area have moved from Oklahoma City to Dallas. LEE KELTON is area sales manager. District offices for the north Texas area have moved from Fort Worth to Dallas, and HAROLD O. EBELING is manager of the Dallas oilfield district. ED MOSES has relocated at Dallas and will lend technical assistance to field personnel in the West Texas-Rocky Mountain area.

DENNIS J. KILLIAN JR. has been promoted to supervisor, Semi Works plant, at Pittsburgh Coke & Chemical Co. Mr. Killian joined Pittsburgh Coke in 1950 as a chemist in the research department. Most recently he served as chemical production staff assistant.

Kaiser Steel Corp.'s new sales offices in Houston will be managed by ROBERT E. BROWN. Mr. Brown has been with Kaiser's sales department for six years. Before being named sales representative in Houston, he was located in the Tulsa office.

Washington • *Cont'd.*

from page 19

vidually have little effect on the final price of gas to consumers.

Some gas industry men are now trying to line up commitments from candidates in the fall congressional elections to support gas legislation when it comes up, according to reports.

Soon, the first stirrings of concrete attempts to draft legislation will get underway.

There will be efforts to draft and push legislation generally following the 1958 Harris-O'Hara bill, which was pushed aside this year after the Texas dinner incident. This bill would have freed producers from utility-type control in favor of market price and commodity regulation.

It would also have prohibited so-called "dump" sales by pipelines directly to industrial customers. This was a sop to the coal interest, in return for their support. It will be in this version of the new bill too, according to reports.

This coal amendment didn't make the pipelines happy with the bill this year. But the pipeliners now have a bigger problem—the Memphis decision which blocks rate increases under the so-called "short" FPC procedures unless all customers agree in advance to pay the higher rates. It will be October or later before the U. S. Supreme Court reviews this case, and midwinter at the earliest before a decision can be expected.

This version of the gas bill may include a provision erasing the Memphis decision to win the support of the pipelines by offsetting the coal amendment.

Rep. Oren Harris (D., Ark.), sponsor of the ill-fated gas bills of the past two congresses, is expected to go to bat for the producers again and introduce the legislation. He has already been heard to grumble that the industry is again going in different directions, and warning

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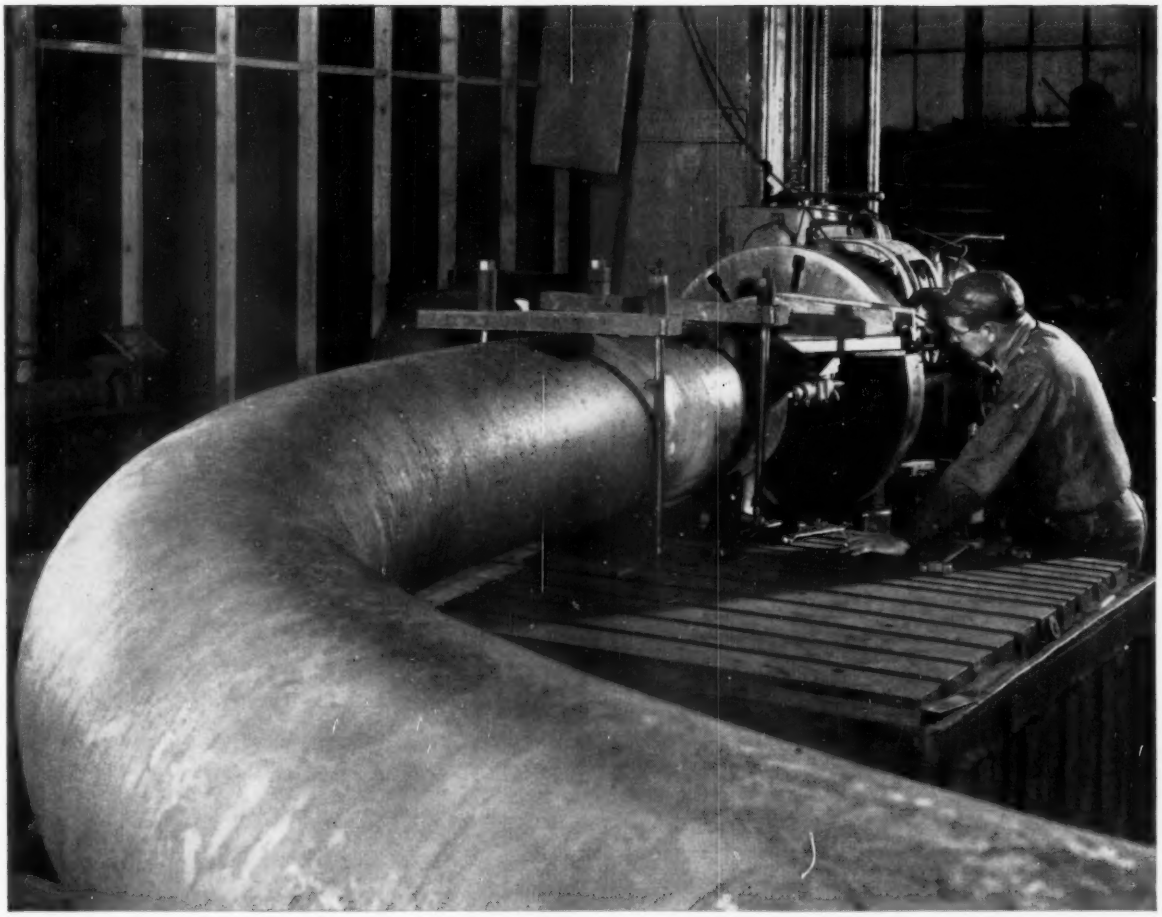

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that the fate of the measure rests on a compromise bill that all groups will support.

As in past years, gas industry togetherness may take a few months to accomplish. Drafts of various proposed gas bills will begin to circulate around Washington and in the industry throughout the country any time now. But it will probably be close to the January opening of Congress before "the" bill is hammered out.

Meanwhile, gas suppliers are claiming that distributors may be forced to go all the way in support of their cousins, the producers and pipeliners, to beat back the rapidly accumulating mountain of federal controls.

If not, the distributors may find themselves without new supplies for expansion, and eventually, perhaps, without supplies to continue existing service.

At least, this is the view of a group of weary lawyers who spend their time in Washington fighting the problems of the producing and pipeline companies.

Latest in the lengthening series of actions which put the supplying segments of the industry more firmly under the thumb of federal regulation is a decision by the Third U. S. Circuit Court of Appeals. This court is located at Philadelphia, and the decision meets all the tests of the proverbial Philadelphia lawyer's approach.

As long as a month after the decision, Washington lawyers were still trying to figure out whether it meant very little, because it was strictly limited to the case at hand (Federal Power Commission and the CATC Group of offshore producers), or whether it had implications which even overshadowed those of the Memphis decision.

In brief, the substance of the court decision was that the FPC had mistakenly approved sale of huge offshore gas reserves in the Gulf of Mexico. Most of the gas would go to Tennessee Gas Transmission Co.

The commission, according to the court, did not decide whether the initial price provided by the contract was in the public interest. The contracts provide for a price of 22.4 cents per Mcf at the start, and increasing to 35.4 cents over 20 years.

The trouble, the court said, arose when the FPC tried to reduce the initial price to 18 cents. The producers announced they would not accept the certificate under such conditions and would sell the gas in intrastate markets to escape federal control. As a result, the FPC backtracked and issued the certificates.

This, the court opined, was a threat on the part of the producers. "Congress," the court said, "has also made it clear that the applicant must be willing to perform the services proposed and conform to the provisions of the (Natural Gas) Act. The action of the applicants in curtailing the decision-making power of the commission demonstrates their unwillingness to conform to the provisions of the Act; this in itself would require the denial of the applications."

The legal eagles were having difficulty interpreting the decision because of the narrow field it covered. They split on its importance, but agreed on one thing:

It may require the FPC to reject any application in which a producer threatens to refuse a certificate if the initial rate is tampered with or a rate condition is attached to it.

They agreed on another fact too:

This decision, coupled with the Memphis decision, makes it all the more important that some form of a gas bill be passed by Congress next year at least prescribing the limits of federal controls if not removing them.

"I've got some producer clients who tremble when they pick up their newspapers every morning for fear they'll find another one of these cases," one Washington lawyer comments.

There was a possibility that the FPC might appeal the Philadelphia decision in the CATC case. Or it might reopen the case, as the court said it should, and conduct a full rate inquiry.

At any rate, the decision can be added to the list of court cases which continue to hurt the gas supplying end of the industry and strengthen the pressure for gas legislation. ■

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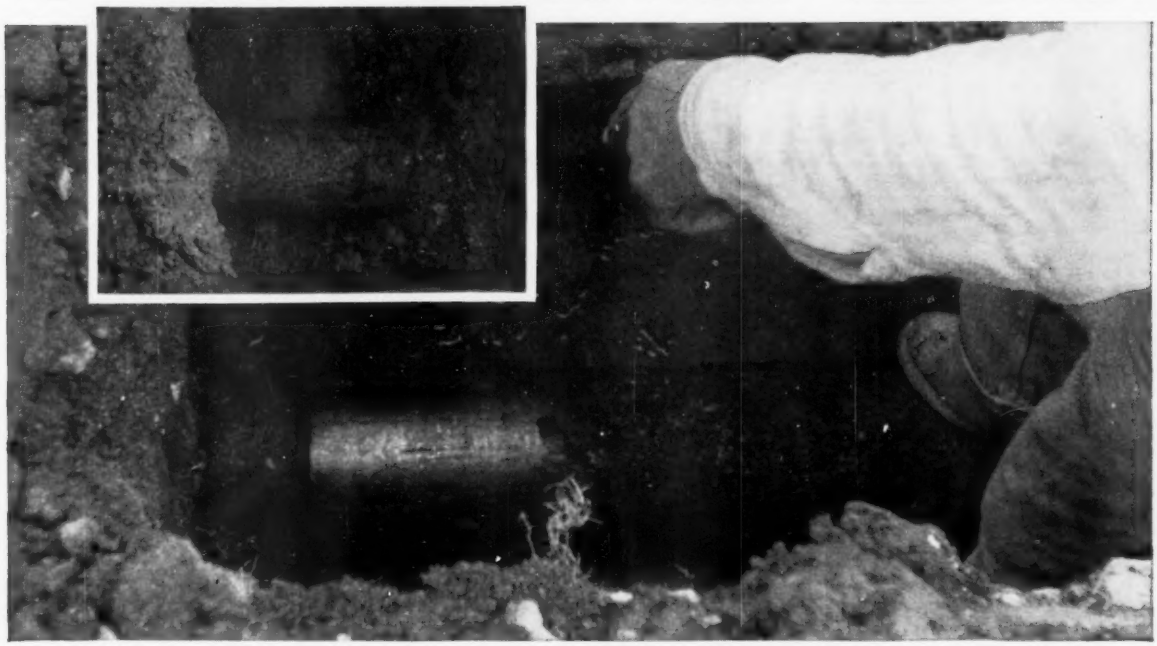

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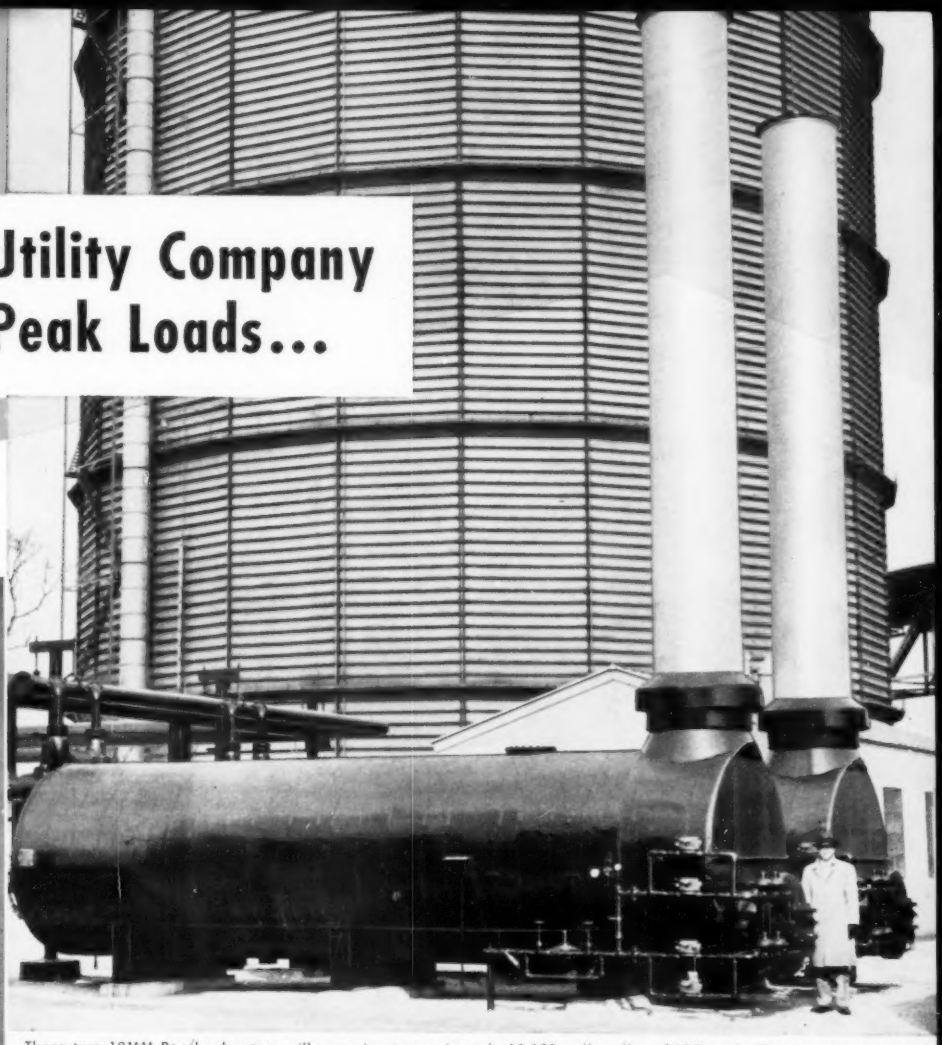

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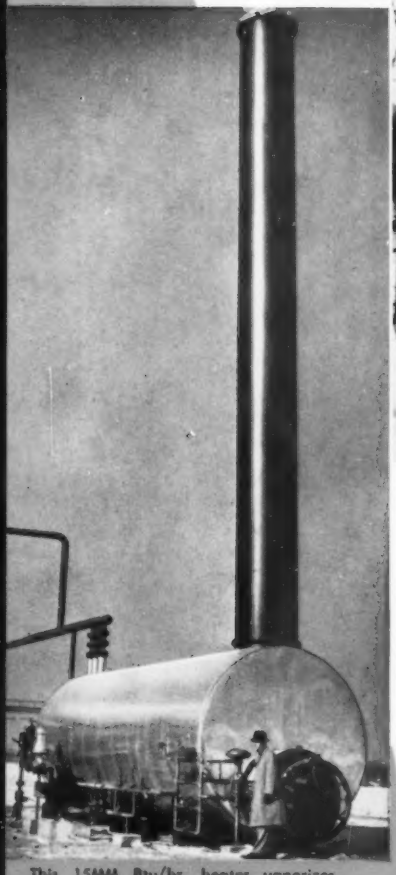

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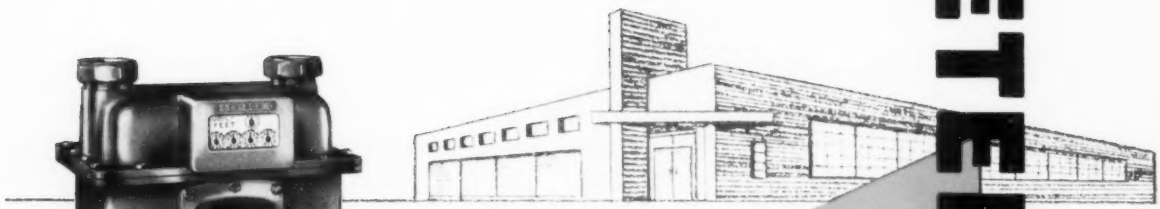

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